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MISSILE DEVELOPMENT AND SPACE SCIENCES

HEARINGS

BEFORE

COMMITTEE ON SCIENCE AND ASTRONAUTICS U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

FIRST SESSION

FEBRUARY 2, 3, 4, 5, 9, 10, 17, 18, 24, MARCH 2, AND 12, 1959

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MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Monday, February 2, 1959.

The committee met in the caucus room, Old House Office Building, at 10 a.m., Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The Committee on Science and Astronautics will please come to order.

Now, gentlemen of the committee, this morning we have just a little bit of official committee business. So I am going to suggest to the committee we go into executive session for about 5 minutes. I think 5 minutes will dispose of what we have, and during that time I regret to say that we will have to exclude everybody from the meeting. And then we will reopen in 5 minutes with the regular list of witnesses that we have this morning, beginning with Dr. Glennan.

I hope you will bear with us in that respect.

Will the committee please come to order?

If there is no objection, we will clear the room and go into executive session.

(Whereupon the committee proceeded in executive session, thereafter reconvening in further public proceedings, as follows:)

The CHAIRMAN. The committee will please come to order.

Gentlemen of the committee, this is the first public activity of the newly constituted Committee on Science and Astronautics. It is interesting to note that the action creating this committee in the House of Representatives, and a parallel action creating a Committee on Aeronautical and Space Sciences in the Senate, represents the first such addition to standing committees of the Congress since 1892, two-thirds of a century ago.

The House of Representatives has recognized that changing times have brought new and grave responsibilities to the Congress, including concern with the larger role for science and the new dimension to human affairs in outer space. Speaking as chairman, all of us appreciate the importance of assignment to membership on this committee, and we will do our best to discharge our duties in service to the Congress and to the American people.

This committee has already held organizational meetings in executive session. This morning we are opening our first hearings. They represent but the first step in an orderly and comprehensive plan of study and investigation during the coming year.

The purpose of these hearings is to present to the members of this committee and, insofar as security regulations permit, to the public at large a picture of the situation as it exists today in the fields of science and astronautics. Although perhaps the principal focus of the hearings for the next several days will be on astronautics, it is important to recognize that this committee is concerned with scientific research across the board. Later work of the committee will explore many areas ranging beyond astronautics.

As indicated in the press release of the committee, the initial phase of the hearings will last for 4 days, to hear from the National Aeronautics and Space Administration, and from each of the three armed services.

As I have previously stated to members of the committee in executive session, this committee has too important a role to fulfill to be influenced by partisan considerations. We shall expect to work cooperatively with agencies of the executive branch of Government to advance programs vital both to the national welfare and to national security. We shall also consider legislation referred to the committee, and shall conduct such inquiries and investigations as may be necessary.

I wish to say that in recent days I have read many conflicting statements by eminent authorities concerning the progress that the Nation has made in the missile program. The more I read, the more confused I become about one thing: They all seem to agree upon the fact that the United States lags behind Russia in the development of the missile program. The degree of lag is dependent upon the authority quoted. The public is confused. These hearings, if they do anything, should clear up this confusion among authorities. We are definitely behind Russia in the development of the intercontinental ballistic missile, so important to our survival. We must overtake and surpass Russia in this respect, and I am sure this committee is resolved to do everything within its power to encourage and stimulate our leaders to reach the goal of overtaking and surpassing Russia in this part of our national defense.

This is no time for kid-glove conversation, but it is a good time to present to the public the plain and unvarnished truth.

This morning, members of the committee, the Administrator of the National Aeronautics and Space Administration is going to begin the presentation for that agency, and he will be followed by various technical experts and division heads to sketch the general outlines of their work and interests.

Our first witness this morning is Dr. Glennan, who is the Administrator of the National Aeronautics and Space Administration.

Doctor, we apologize for holding you there. If you will come forward and have a seat.

Before you start your statement, my colleague from Pennsylvania has a short statement to make.

Mr. FULTON. We on the Republican side want to join with our chairman and the majority leader in looking into these programs to see just where the United States does stand at the present time.

I don't think that I personally can go along with any blanket statement as to who is ahead, either Russia or the United States, because that is the purpose of our investigation. Obviously, they are ahead in some fields and we in the United States, from my own experience, are ahead in other fields.

The question then among authorities is: How important are those fields, first, to our national safety and security, and, secondly, to scientific advancement?

For my part, I put the programs on ICBM's, as well as the other missile and guided space vehicles, on a much broader basis than their military use or their place in competition with Russia. I believe we have many economic gains to be made, such as weather control, weather prediction, peacetime television, operating the Post Office Department, maybe, in the period of an hour, through having 20 to 30 missiles in the air, from which we either send or receive messages. The field is much broader than a race with Russia, and we in this committee, I hope, on the Republican side, will see that the implementation is given for broad scientific advances, not only for our security in a race with Russia but for the benefit of all mankind.

Lastly, I believe we on this side want to see these scientific advances made available for the whole world—all the scientists—so that every people, that is, our allies as well as the people behind the Iron Curtain, can move ahead, raise their standards of living, and arrive at a peaceful world.

Thank you very much.

The CHAIRMAN. Thank you, sir.

Now Dr. T. Keith Glennan, Administrator of National Aeronautics and Space Administration.

Doctor, you have a prepared statement. We will be glad to hear you as our first witness in the first session of this committee. I think this is an historic occasion.

STATEMENT OF DR. T. KEITH GLENNAN, ADMINISTRATOR OF NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. GLENNAN. Thank you, Mr. Chairman.

I am delighted to have an opportunity to appear before you and to see so many of the committee members in attendance this morning.

Before I do read this statement, I would like to introduce to the committee a man who I guess is known to most of you, Dr. Hugh Dryden, the Deputy Administrator, and Dr. Homer J. Stewart, who is Director of our Office for Programing, Planning, and Evaluation.

Now, if I may proceed.

Mr. Chairman, members of the committee and counsel, several days ago I was privileged, as indeed were some of you, to attend the cere-

mony at which the Army presented to the Smithsonian Institution on the first anniversary of its historic flight, a replica of Explorer I, the first U.S. earth satellite.

As I sat there, recollections raced through my mind of some of the many things that have happened in the year since we began our scientific exploration of space. Four additional U.S. satellites have been sent into orbit, carrying instruments for producing new scientific information of great importance. Two U.S. space probes have been launched to a maximum distance of 71,300 miles from the earth. In that same 12-month period the U.S.S.R. has launched an additional satellite with a very large payload and has sent the first probe beyond the moon and into orbit around the sun.

During this same period much more has happened. As a Nation we have been engaged in the most sober and intense assessment of where we stand in space technology, space science, and space exploration; we have pondered where we want to go in those areas, and what we must do to reach our goals.

We have faced up to the fact that we shall have to make the most earnest effort if we are to reach the goals we have set for ourselves. We have had to understand, also, that this is to be a continuing competition on a variety of fronts, scientific and economic as well as military.

As Dr. Hans Selye, director of the institute of experimental medicine and surgery of the University of Montreal has written:

> We must educate our children to understand that from now on man's great wars will not be fought with muscle. His battles will not be won by the glorious, intoxicating, momentary courage to face danger and die for a cause. Our children must learn that the great victory in peace and war will be won by warriors of a different stamp, men of intellectual vigor, and by the sober, persistent dedication of their entire lives. They will have to learn that it is far more difficult to live than to die for a cause.

A principal reason I am here today is because the Congress and the executive branch were in agreement that, and I quote from the Space Act of 1958, "activities in space should be devoted to peaceful purposes for the benefit of all mankind." In my opinion, as Americans we can be rightly proud that our country for the past year has led in efforts to establish a climate of international opinion that will give real meaning to the principle that space flight is, or at least should be, inherently international and peaceful in its intent.

As you know, the Space Act requires that—

> activities peculiar to or primarily associated with the development of weapons systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the concern of the Department of Defense.

There are large areas of space activity where there may be a duality of interest, both civilian and military. On May 21, last, the Select Committee on Astronautics and Space Exploration of the House, in its report, "The National Space Program," recognized this duality of interest and use. In such instances, and I quote from the report:

*** * * their primary purpose should be declared civilian. If we do not do this, we automatically commit the world of the future to the same stalemated life in armor which is lived by the world of today. If the very efficiency of current weapons virtually denies the practicable possibility of total war, further strides made in our rocket development would probably intensify this denial. The entire purpose of our effort should be to insure that the peaceful uses of these devices prevail. This is the stated philosophy behind our space exploration. It is the philosophy of this country.**

The probable material benefits of space exploration are both direct and indirect and may be applicable both to civilian and military activities. The first practical applications appear to be those of satellites to the problems of worldwide communications and of meteorological research and weather forecasting. The last satellite launched by the United States, the Atlas, demonstrated in dramatic fashion some of the potentialities of a communications satellite. This accomplishment is but the first step in a development expected to lead to an economically-sound, wide-band, reliable worldwide communication system. Such a system would permit the transmission of television programs, if the use of the system for such a purpose were considered desirable.

A meteorological satellite would enable worldwide observation of clouds and other aspects of weather as suitable methods and instruments are developed. At present there are available weather observations from a limited number of stations on the land masses of the globe and from a few ships at sea. The much greater amount of information from the worldwide coverage of the satellite would, when suitably processed, increase the accuracy of weather forecasts. Economic studies have shown very large dollar savings from relatively small improvements in accuracy. More accurate forecasts have tremendous economic implications for agriculture, food-processing industries, public utility companies, and numerous other industries.

There are other applications of satellites to more special uses such as navigation and geodetic measurements. Beyond these we enter the realm of speculation and prophecy. We do not know the ultimate role of space vehicles in transportation any more than the few spectators of the early flights of the Wright brothers knew of our present jet transports which make the world a neighborhood. Some speculate that the moon and the planets represent a vast new physical frontier, a source of new material wealth, but at present this cannot be demonstrated. Suffice it to say that there are some clearly-seen material benefits to human welfare from space exploration, and that there are others, probably more significant, hidden from our view. I am personally convinced that these now-hidden gains that will accrue from our national space programs represent future payoffs of incalculable value, very possibly outweighing greatly the investments that will be required.

I have referred to the goal of our national space programs as the opening of space to mankind. Such an aim embraces the many interests of man himself, the material and the spiritual. To explore space to gain additional knowledge about the universe in which we

live, to open space to the travel of man, himself, to open space as a demonstration of one's mastery of advanced technologies, all these reflect as in a mirror the insatiable curiosity of the human mind.

Our space science program is already providing much new knowledge about space which has led to the postulation of new theories about the earth and the environment surrounding it. And we have only begun to accumulate this new knowledge. High priority is being given to the study of energetic particles. In the immediate program, the interactions of high energy particles with the earth's atmosphere and field will be studied intensively and the types and energy of such particles and their spatial distribution will be measured.

Of specific interest are the measurements of cosmic-ray intensity in interplanetary space; of time and latitude cosmic-ray intensity variations; of composition and spatial extent of the great Van Allen radiation belts around the earth; of the cosmic-ray energy and charge spectrums, and of the nature of the particles producing auroras. Measurements will be extended as far as possible toward the sun and toward the outer reaches of the solar system, including the interactions of energetic particles with the atmospheres and fields of the planets.

These are but the an indication of the broad program that must be undertaken in the years to come. In our selection of the scientific space experiments to be conducted, we look for advice to the Space Science Board of the National Academy of Sciences. This board of 16 scientists is headed by Dr. Lloyd V. Berkner. It has already been helpful with reference to the immediate program for scientific exploration of the space environment. It also has in preparation a comprehensive report on the longer range scientific objectives with respect to the study of many physical phenomena relating to the moon, planets, and interplanetary space.

So far, my discussion has been focused on the objectives as expressed by the administration and the Congress, that our space programs shall be peace-oriented. Others appearing before your committee will deal with military interests in space technology.

Now, I want to speak about the National Aeronautics and Space Administration.

The Space Act provided expressly that NASA should become operative 90 days after its enactment, July 29, or on any earlier date that the Administrator might determine. We shortened this 90-day period of preparation by one-third, and as of the close of business, September 30, last, NASA was in operation.

To get going, we have had to organize with one hand, while, at the same time, we are trying to operate with the other. This, we all know, is not the most efficient way to do business. There was not then, and there is not now, time for us to proceed in the most orderly fashion.

At NASA we have accepted the realities of the situation. We have improvised task-force teams that by brute effort could get done as quickly as possible what had to be done. We recognize, however, that

for the long pull, we must accomplish proper organization of our people to insure that they function smoothly as an efficient team. This we are doing at the fastest possible rate.

Fortunately, it was not necessary for NASA to begin from a standing start. The Space Act provided for transfer to NASA of, and I quote, "all functions, powers, duties, and obligations, and all real and personal property, personnel (other than members of the Committee), funds and records" of the NACA, the National Advisory Committee for Aeronautics.

In the transfer, the important item was not the $350 million value of the finest of research facilities or even the comprehensive flight research programs of the NACA that ranged all the way from problems affecting vertical takeoff and landing aircraft to those peculiar to satellites and space probes.

What was really important in that transfer was the group of nearly 8,000 scientists, engineers, and supporting personnel that we inherited from NACA. Last August at the confirmation hearing when I was asked what I thought my job called for, I said, "It isn't just a matter of the money that is involved, but it is a matter of the people involved and how one best can motivate the people to highest performance." I have had no problem providing the motivation to obtain highest performance from these people. They believe very earnestly in what we are trying to do. They feel the urgency with which we must do our work. They are experienced and talented people who are contributing effectively to the national space effort.

In this manner, we were provided with first-rate research activities on a broad front in both aeronautical and space. There were, however, other research, development and operational areas in which NASA had to become deeply involved to accomplish its total mission. These included electronics, guidance, rocket systems, and so forth.

There were two possible, obvious solutions. One was to begin selecting sites, constructing and equipping new facilities, and then undertaking the painful process of staffing the new laboratories. Such a solution would have been very expensive. It would have required the raiding of staff from other organizations. Most serious of all considerations, it would have delayed our progress very materially.

The other solution, and the sound one, I believe, was to acquire facilities already doing outstanding work in the required areas. This is the course we have been following.

The President, on December 1, transferred to NASA from Army jurisdiction the Jet Propulsion Laboratory at Pasadena, Calif., operated under contract by the California Institute of Technology. By this action, NASA acquired a high order of capability in electronics, propulsion, systems analysis, and in tracking and telemetry.

We requested also that the Army transfer to us a portion of the Army Ballistic Missile Agency at Huntsville, Ala. Such a transfer would have given us an imaginative, competent engineering and design group capable of serving in the planning and executing of both

short- and long-range programs in the development of boosters and vehicular systems. Such a group would have served also to monitor contracts with other governmental agencies and with industry, to provide a necessary ground testing and assembly capability, and to supervise all launching operations for NASA.

The Department of Defense determined that the Army Ballistic Missile Agency's special talents were necessary to the accomplishment of certain missile projects vital to the Nation's defense posture. We did not wish, of course, to interfere in any way with our defense effort, and, in fact, had included this proviso in our original request. Although the Department of Defense was unable to agree to the transfer, arrangements were made for ABMA to be "completely responsive" to requests of NASA for the performance of such work as we desired and the Army felt could be done without interference to its military projects. It is too early to say if this arrangement will be adequate for our needs. The Army has assured us of an earnest desire to be fully cooperative within the framework of existing limitations, and we intend to make the fullest use possible, under these circumstances, of the ABMA capabilities.

The Presidential order of October 1 transferred certain programs and projects already underway. These actions included, for example, a study contract the Air Force had with Rocketdyne Division of North American Aviation to determine the feasibility of undertaking development of a single-chamber rocket engine in the 1½-million-pound-thrust class. Included also in these transfers were the Vanguard project and several Air Force and Army space probes then under the administration of the Advanced Research Projects Agency of the Department of Defense.

The President has assigned to NASA the development of the national space program. In this effort we are working, of course, in closest cooperation with all other elements of our Government, particularly with the Department of Defense. Our method has been to deal substantively with each of the major elements of the problem.

We have had to face up to the fact that we do not have available booster rockets sufficiently powerful to put into orbit or send on long journeys into space, the size payloads required to obtain the scientific information that is needed. This fact is made no more palatable by realization that today and for some time to come the Soviets have rocket boosters permitting them to send into space payloads heavier than we can manage.

We need a whole family of new rocket boosters and upper-stage rockets that, used singly or in combination, will give us the amounts of thrust we need to accomplish our missions in space. Because these boosters of varying capabilities are necessary for both civilian and military space programs, NASA undertook the development, with DOD, of an integrated program aimed at correcting this situation as soon as is humanly possible.

This program is based on a minimum number of rockets that will be used as building-block units in combination to meet expanding

mission requirements. By midsummer of next year or shortly thereafter a new, second-stage rocket engine, when used with an Atlas, will permit us to put approximately 6,000 pounds of payload into orbit, or send about 1,000 pounds of payload as far as the moon. Another rocket engine now being developed, also for use as the second stage of vehicles using the Atlas or Titan booster, will have been completed by early 1961—little more than 2 years from now—which will enable us to put 8,000 pounds of payload into orbit, and send a 2,000-pound payload to the moon. NASA and DOD are working together in the development of these and other upper stage rocket motors.

Clustering existing big rocket motors will provide a first-stage booster having a thrust of 1½ million pounds by 1962. Engines of this cluster, procured under DOD auspices, are now in production, and the engineering on the total power package is well advanced. It will permit us to put 10 tons of payload into orbit and to send 2 tons of payload into deep space, for beyond the moon.

Development of a single-chamber rocket booster designed to deliver 1 to 1½ million pounds of thrust is also being pushed, to bring it to a stage of usefulness inside of 4 years. Within 2 years thereafter, we believe we will have learned how to cluster four of these giant rocket motors, to provide a first-stage booster with 6 million pounds of thrust. It will lift 75 tons of payload into orbit.

Another problem area—that of guidance and control—requires particularly heavy emphasis both in planning and implementation. Development of midcourse and terminal guidance systems is clearly also necessary. Above all, simplicity and reliability must be built into these systems. Our principle task at the moment is to acquire information about the space environment—and this calls for reliability in getting our instruments aloft, whenever and wherever we may want to make our measurements.

Still another problem—to expand our capacity for tracking and data acquisition—is now well on its way to solution. Additional stations will be established in this country and abroad. These stations may be manned, in some instances, by nationals of the countries where they are to be located. Still further expansion of these networks will be required, as time and our programs move forward together.

Perhaps the most difficult of our problem areas is our understanding of the capabilities of man himself in this new and exciting adventure into space. While much progress has been made, intensive effort is required to assure us that the men who volunteer for space flights possess the physical and mental capabilities to withstand the rigors of flight into space.

Whatever the problems we may encounter in this particular area, I find it difficult to believe that we shall fail in our efforts to surmount them.

To focus all of these research and development activities, and give them real meaning—to sharpen the determination with which we tackle these problems—we have undertaken Project Mercury, an attempt by this Nation to send man into space. Last month, NASA

chose the McDonnell Aircraft Corp. of St. Louis to design and produce the prototype of a capsule to carry the man in this project.

Selection of the pilot astronauts has already begun. Initially, we will need a dozen men, chosen with greatest care from a group of volunteers. The group will be totally involved for many months in a program of rigorous training for the first orbital space flight.

Although this first orbital flight by our modern Mercury will surely be a pioneering venture, we are determined that the risks to the pilot will be no greater than those experienced during the first flights of a new, high-performance airplane. As in such airplane flights, the astronaut will play a vital role in the Mercury project. Repeated flights of the space capsule, first carrying only instruments, and later animals, will have tested and proven the practicability of the final phase of Project Mercury—manned satellite flight—before it is undertaken.

I have referred to one other aspect of Project Mercury as being, in my opinion, of the utmost importance. Sending man safely into space is an arm-stretching, mind-stretching undertaking that thrills every one of us, and demands from every one of us the very best we can muster. It is a focal point for all our energies, all our enthusiasms, all our determination. It will result in much earlier development of the technology needed for other difficult space missions.

Ever since I took this job as NASA Administrator—it is now 5 months ago—I have been saying that our space mission is so vital that we must carry it forward with the same sense of urgency we had during the war. I have made this comment so many times that some people might think that this phrase is becoming a cliche. But I know of no better way to say something that all Americans must believe and practice if we are to make maximum progress in this field.

We have the resources. We have the intelligence and the technical skills. We certainly have the necessary wealth. What we have to decide is—do we have the determination, the willingness to roll up our sleeves and get the job done?

As I see it, success of our national space program depends upon three factors: Time, money, and effort. We are behind the Russians on the time scale because they have bigger boosters. We shall have to spend large sums of money and work harder to attain our space goals as soon as we want.

This past year, we have shown we can move, but we have only started. The need is for urgently sustained effort for years to come. If our space programs are to be run on an off-again, on-again basis, zigging and zagging with the turn of every new year, then we'd better spend our money buying telescopes to watch the Russians pioneer in space.

The CHAIRMAN. Thank you, Doctor, for your very strong statement. The last part of the statement is the portion of it which impresses me most. The part in which you state that "we can whip this problem, given the time, money, and effort. What we need is the determina-

tion." I think the American people have the determination now. With your help we ought to be able to go ahead and catch up and pass the Russians.

I read your speech, Doctor, given before the Institute of Aeronautical Sciences in New York City. You begin that speech by referring to misunderstandings. I think you state there is a misunderstanding in the short-range program and in the long-range program of your administration.

Now, will you explain to this committee, what you have in mind by short-range program and long-range program?

Dr. GLENNAN. I would be very glad to, Mr. Chairman.

This misunderstanding came about, if I may be permitted to explain it, as a result of the use, shortly after the first of the year, of a very short clip from a recording that was made rather early in November last year when I had been on board about a month. And I was asked whether we had a long-range program and I said that this was one of our first tasks, the implication being that we did not have a long-range program. That indeed might be said to be partially true, because it takes time to develop a long-range program, and it is very easy to quibble about what is a short-range program and what is a long-range program. We have developed, and it is supported by our budget, actually, a well-rounded program for the next 2 or 3 years, including booster development, Project Mercury, space science activity and a variety of activities. We have undertaken, area by area, the development of a long-range program for the Nation which would extend over a period of 5 to 15 years.

This will be done in the areas of guidance, in the areas of payloads, in the areas of booster, in the areas of tracking, et cetera.

The CHAIRMAN. I have read a series of stories recently, Doctor, in reference to Mechta, I believe the Russians call it, the project which they sent up to probe the moon, but which they say bypassed the moon and went into orbit arount the sun.

I have also read that this was a hoax and that this missile did not bypass the moon, did not get into the sun's orbit. Have you any comment you would like to make in reference to that?

Dr. GLENNAN. Mr. Chairman, I would like to make a comment, then I would like permission for Dr. Stewart to comment on the technical aspects of this. It seems to me we do ourselves no great good by doubting the statements of our Russian competitors in fields of science when they say they have accomplished something. I have had personal experience in visiting Russia and seeing the results of some of their activities and I have respect for their scientific accomplishments.

I think that we can—we ought really not to kid ourselves about their abilities in the scientific fields. Now if I might ask Dr. Stewart to speak on this point.

Dr. STEWART. Mr. Chairman, I think the best way to answer this——

Mr. McCormack. Will you speak up so all members can hear?

Dr. Stewart. All right. I think the best way to answer this question is to describe some of the activities that went on at the Goldstone tracking station operated by the tracking laboratory, part of the NASA establishment, on the evenings after the Russian launching was announced. They had no prior warning, of course, so that there was no way to assemble the highly sensitive specialized equipment that is normally used for this kind of purpose.

However, they did hear the Russian announcements on the frequencies on which they were operated and they did assemble the best qualified commercially available equipment that was on hand and set out to try to see what they could do in the way of tracking the Russian vehicle.

The first night they had no particular success. During the Saturday following they worked over the equipment, found some areas where, in the haste to assemble it, things hadn't been done quite as well as they might and significantly increased the sensitivity.

On the second night they did receive signals over a period of several hours. They were not high quality signal reception, in that the signals were noisy, but they did have them good enough so that they could lock on intermittently for several hours.

If you take the information that was obtained this time with regard to the pointing angles of the big dish and plot it on a curve which corresponded to the kind of expected course you would have if the Russian announcements were indeed correct, there was reasonable verification.

So in view of this, I think that there is no reason whatsoever to doubt that the signals were indeed coming from a vehicle in free space following a path very close to what the Russians had announced.

Mr. McDonough. Will the gentleman yield?

The Chairman. I yield to my friend.

Mr. McDonough. Were the impulses which you received on the same cycle as those of the existing Russian satellite in orbit at that time?

Dr. Stewart. There were signals on several frequencies. The Russians announced their signals on several frequencies. Two or three of these, as I recall, were in the neighborhood of 20 megacycles, quite close to that of Sputnik III.

Mr. McDonough. Wasn't the tone similar to Sputnik III?

Dr. Stewart. As a matter of fact, this is one trouble they had. They several times thought they were tracking it and it turned out it was Sputnik III they were tracking. However, the particular items that I was referring to a few moments ago were on a much higher frequency, I believe it was 183.5 megacycles, which was not used on Sputnik III and which thus is rather independent of this particular question.

Mr. Fulton. Will the gentleman yield?

The Chairman. I yield to my friend from Pennsylvania.

Mr. Fulton. As a matter of fact, on Russia's deep probe shot, what really happened was that there was just a lack of signals after a certain point, so we don't know what happened to it. There is no

verification, is there, other than an assumption, that that shot is now orbiting the sun?

Dr. STEWART. The period in which this tracking that I referred to was accomplished was the period in which the rocket was in the general neighborhood of the moon. Having come close to the moon in that short a period, I think there is no reason to doubt—it has to be orbiting the sun, it just can't do anything else.

Mr. FULTON. But we have no signals or no method of practical knowledge through instrumentation that such is the case?

Dr. STEWART. This is true, we have no further indication beyond that.

The CHAIRMAN. We have the last signal—the last signal we got from that missile was when it was in the vicinity of the moon. We assume that it is therefore orbiting the sun, because we don't know anything else.

Dr. STEWART. It would be very difficult to conceive of any situation which would permit a missile to come close to the moon, that fast, and not end up by orbiting the sun. This is what—it might have run into the moon, conceivably or be otherwise destroyed.

The CHAIRMAN. You don't think there has been any hoax put over on the American people.

Dr. STEWART. I have no reason to suppose that that is the case.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. Then the statement by an individual and several individuals that there had been Russian satellite or sputnik signals from a point beyond the moon—both in this particular case and on a previous case several weeks before—were not accurate?

Actually what they may have been were reflections from their sputnik which was already orbiting, is that not right?

Dr. STEWART. I am not familiar with the particular episode you are referring to, Congressman.

Mr. FULTON. There was a gentleman of some authority who came to Pittsburgh and stated that there had been signals received from outer space from a Russian instrument much before this particular instance we are speaking of. Was that not a case merely of the reflection of instrumentation signals from already orbiting sputniks?

Dr. STEWART. I am not familiar with the episode so I can't say. I might add, though, which may have some bearing on this report, that one of the greatest difficulties that the boys at Goldstone had in this tracking episode that I referred to was the confusion with various kinds of radio signals reflected from the moon.

Mr. FULTON. Possibly Dr. Glennan or Dr. Dryden know of that instance.

Dr. GLENNAN. I personally have no knowledge of it, Congressman Fulton.

Dr. DRYDEN. I have no knowledge.

Mr. FULTON. Thank you.

The CHAIRMAN. I have some other questions. I am going to ask you one or two more questions and then I am going to yield, because the time is getting late, but we will be in session this afternoon and

I want every member in the committee to have an opportunity to ask questions.

I want to ask you this: You referred to the urgency of the program, Doctor, but it is on a crash basis at this time?

Dr. GLENNAN. By a crash basis, Mr. Chairman, I presume you mean that all caution is thrown to the winds and we just spend money very, very loosely. The program is not on the crash basis under that definition.

The CHAIRMAN. Well, that is not quite my definition, but how close would you go, in the efficient use of money, and the proper use of public funds, toward putting this program on a crash basis? That is, an all-out basis to get something accomplished?

Dr. GLENNAN. We are doing just that, Mr. Chairman. We are working as diligently and effectively as we can. We have brought into the program substantial numbers of very able people. We have added to our organization, the Jet Propulsion Laboratory and other elements of other laboratories in other parts of the Government. I think—I would describe our activity as one being pursued with a very great sense of urgency.

The CHAIRMAN. Would you say it is a crash basis with the waste of funds absent, the efficient use of funds present?

Dr. GLENNAN. I would say it is under the very greatest head of steam we can muster at the present time.

The CHAIRMAN. When are we going to overtake Russia under that head of steam?

Dr. GLENNAN. I don't think it is possible for anybody to make a prediction as to when we are going to overtake Russia.

Mr. ANFUSO. Would you yield at that point?

The CHAIRMAN. I yield to the gentleman from New York.

Mr. ANFUSO. Mr. Glennan, you have made certain estimates as to when we can expect to develop certain rocket engines necessary in the exploration of outer space for both peaceful purposes and the security of our country.

Can you tell us what can be done to reduce the periods given by you? Are you saying now to the chairman and to this committee that nothing can be done to reduce those periods?

Dr. GLENNAN. Mr. Congressman, I think that we have those booster programs under as heavy a head of steam as we can get them. It would be possibly, I presume, I am sure of it, as a matter of fact, to perhaps have greater assurance that one would be successful in the programs we undertake by spending substantial sums of money beyond those which we have now programed. But to shorten the period is not, in my opinion, a matter that can be speeded very much.

Mr. ANFUSO. Mr. Glennan, under those estimates, by the time we reach them, Russia will be far ahead of us and they will be so far in front that we could never catch up the rate that we are going. That is the point that I am trying to get at. Is there anything that can be done by way of money, by way of manpower, to increase the pace that we are going in order to catch up with the Russians and finally pass them?

Dr. GLENNAN. Mr. Congressman, this program doesn't hinge, alone, upon our ability to get the heaviest possible payloads into space. We, I think, as a nation, are being deluded a little bit into pinning the total program on the thrust of the boosters that we use.

The program which we have underway today in acquiring new scientific information is the important program here; it is what information we can get back from outer space that is important.

We will have the boosters in time that will allow us to make multiple observations during a single satellite flight or a single polar flight. Now your specific question about trying to get a bigger booster in a shorter period of time, I would think it reasonable for me to state that we have laid on the program that we believe will get us with assurance the booster in the shortest possible time.

I would ask my colleague, Dr. Dryden, if he might want to comment on that.

Dr. DRYDEN. I think, Mr. Chairman, that the experience in this field has taught that it takes a certain amount of time to begin from scratch with an idea, and produce hardware of an assured performance. I can only repeat that we believe that we have set forward a time scale which can be accomplished with all the pressure that can be put behind it, that the use of more money could result in starting parallel programs, to give greater assurance of success, but we are not sure that this would reduce time.

In fact, the division of management over two programs would not guarantee that the time would be reduced.

Mr. ANFUSO. Mr. Chairman, I haven't gotten clearly an answer to any question and I would like to get it.

What this committee, I believe, wants to know, and what I think the American people want to know, what the entire free world wants to know is: Can we catch up with the Russians, and how fast? Now, if you can't give us an estimate as to what we can do now, will you please come back at some other time, as soon as possible, and tell us? I am sure that there must be something more that we can do. And if there is something more that we can do, I think that the American people want to know that, and they want to know it now.

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller from California?

Mr. MILLER. Dr. Glennan, isn't this just the old frustration that overtook us at the outbreak of World War II, when Congress appropriated money for 20,000 antiaircraft guns and the American people then said: "Where are the guns?" 2 weeks later.

Dr. GLENNAN. There is a certain element of that in it, Mr. Congressman.

Mr. MILLER. In other words, we are not dealing with a commodity on the shelf that money can go in and buy, isn't that true?

Dr. GLENNAN. That is quite true.

Mr. MILLER. So that it isn't a question of giving you more money, it is a question of letting you get these teams dovetailed and working together, the NACA, the Jet Propulsion Laboratory and so forth.

Frankly, I think the Army's failure to turn over its facilities to you is not contributing to the solution of this problem. Is that true, that getting the scientists together, getting them working together to eliminate those who are not making the contribution is the big thing that you are up against right now?

Dr. GLENNAN. There is—you are quite right. There is no other way to do this.

Mr. MILLER. And you are pursuing this program now to the best of your ability, and those associated with you, to do this?

Dr. GLENNAN. That is quite correct, sir.

Mr. MILLER. As far as I am concerned, the only thing we can do is put our faith in these people. I don't know of any other way that we can hope to meet the——

Mr. ANFUSO. Well, Mr. Chairman. May I say this: Believe me, it is not the absence of faith that prompted my questions. We must rely on faith, we must rely on you people. All that I ask, I am sure every member of the committee is interested in it, is, Are we doing the best we can? Can we do more? And if we can, let's tell it to the American people.

The CHAIRMAN. I have one more questions to ask now and then I am going to start alternating and I will ask the committee to bear with me until I get this question out of the way.

Doctor, you all testified that a million-and-a-half-pounds-thrust engine was 5 to 8 years away.

Now, you testified, I think, in the Senate, that such was possible in a shorter period of time.

Now, is it your idea that you are correct, and Dr. York is correct, or that in following the line of these questions—we could do something additional to speed this up and get a million, million-and-a-half-pound-thrust engine in a shorter period of time? That is what we really need, a stronger booster.

Dr. GLENNAN. To get heavy payloads into orbit we need greater thrust. The clustered engine utilizing pieces of hardware that presently exist is under development, design, development and construction, actually, at ABMA at the present time and one hopes that a flight article, that is a useful vehicle, will be ready sometime in 1962.

Now, the statement made by others relating to the single-chamber million-and-a-half-pound-thrust engine, where we, I believe have said we expect, within 4 to 6 years, not 5 to 8, but rather 4 to 6 years, will be available, I think here you are in this realm of speculation where honest men may differ.

I would like to get on the record one particular point: One of the things that has impressed me about the groups that we have brought into this organization and particularly NACA, is that they are groups of people who understand the word "integrity," and my purpose is to be just as factual and straightforward as I can and to maintain the integrity of NASA, in its dealings with you and with the American people.

And we are not going to go out on a limb and make promises that we cannot support. We may be wrong, but we will be wrong because we are honest in our estimates.

The CHAIRMAN. Mr. McCormack?

Mr. MCCORMACK. No, I will pass.

The CHAIRMAN. I understand Mr. McCormack has to go to the floor. So I am asking him at this time. If he has no questions at this time, I yield to Mr. Fulton——

Mr. MCCORMACK. I will ask one question which occurs to me. Of course, the propulsion power is a matter of primary importance.

Dr. GLENNAN. Yes.

Mr. MCCORMACK. You can't downgrade that.

Dr. GLENNAN. No, sir.

Mr. MCCORMACK. That is vitally important in sending up larger vehicles or satellites, instruments, call them whatever you want, and to

get scientific knowledge that is not available now, even on the small satellites that we are sending up. How far ahead of us would you say the Soviets are in propulsion power, in the development—let me ask you this question: What propulsion power did it take to send their last instrument up into space?

Dr. GLENNAN. Here again I think that honest men differ in their estimates of this. Dr. Stewart, who can speak for himself, says that if they are very sophisticated in their use of these devices, that it might take only 250,000 to 500,000 pounds of thrust. Others have graded this up from half a million to a million pounds of thrust. I expect I am a little bit in this latter camp.

Now, we ought to be, as I think I have testified, in a position within some 18 months, 18 months to 2 years, to send into orbit the sort of payloads and even more than they presently have done.

Mr. MCCORMACK. Where do you expect they will be then?

Dr. GLENNAN. I expect if they think it is important to increase their payloads, I would expect that they should have progressed as well. But it seems to me, Mr. McCormack, that the genius of this Nation has been in its industrial development, in its ability to get on with jobs of this kind. What has been done in this past year is little short of miraculous, from a standing start, in effect. And I have no hesitancy in predicting, if I may use that term, that we will close this gap. But not knowing what pace the Russians are operating at, except that I think they are diligent about it, I don't presume to be able to guess that we will be matching them, if indeed we should be matching them within 3 years.

Mr. MCCORMACK. I will agree that we shouldn't follow them. On the other hand, you can't ignore what they are doing. Is that right?

Dr. GLENNAN. Under no circumstances.

Mr. MCCORMACK. It is a relative situation.

Dr. GLENNAN. That is right, sir.

Mr. MCCORMACK. Right across the board.

Dr. GLENNAN. That is right, sir; and in many other fields.

Mr. MCCORMACK. Have you any expectation they will send a man into space this year?

Dr. GLENNAN. I just don't know.

Mr. MCCORMACK. Beg pardon?

Dr. GLENNAN. I just don't know, sir.

Mr. MCCORMACK. You wouldn't——

Dr. GLENNAN. I wouldn't put it past them.

Mr. MCCORMACK. In other words, you wouldn't be surprised if they did?

Dr. GLENNAN. No, I don't think I would.

Mr. MCCORMACK. Our program for that is several years off, isn't it?

Dr. GLENNAN. Yes, it is.

Mr. MCCORMACK. That is all for now.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. Following Mr. McCormack's line of questioning, obviously when there are so many fields of various kinds, it is like comparing horses and rabbits and chickens and ducks and saying, overall, which is the best species or which is—or which is most advanced in the development of intelligence, is that not right?

Dr. GLENNAN. Yes, sir.

Mr. FULTON. So that it is not really logically or intellectually possible to say who is ahead between Russia and the United States, or the free world, unless you say what kind of a program is involved and what the object is, is that not right?

Dr. GLENNAN. That is right, sir.

Mr. FULTON. And on many programs we are very much ahead of them because we have very sophisticated instrumentation and have done a lot more than they have?

Dr. GLENNAN. That is right.

Mr. FULTON. While on others we have not emphasized weight and things of that type; is that not right?

Dr. GLENNAN. That is right, sir.

Mr. FULTON. Then can you give us some estimates on worldwide television, for example. How soon will we have that for peacetime uses or military uses?

Dr. GLENNAN. Mr. Fulton, could I ask Dr. Dryden to speak to that?

Mr. FULTON. And Dr. Stewart, anyone of you.

Dr. DRYDEN. This, again is a——

Mr. FULTON. If you would give your estimate first and then explain, because I have four questions on this point. You just give an estimate as to your programing, and then the explanation about it, really very briefly.

Dr. DRYDEN. A guess, and it is hardly more than a guess, would be 4 or 5 years.

Mr. FULTON. No, I want your estimate. How about you, Dr. Stewart.

Dr. STEWART. Well——

Mr. FULTON. I am talking of your long-range program, so I don't want guesses.

Dr. STEWART. To answer your question, I must do it in two pieces. First is the program we are starting which does call for some initial tests, hopefully within a year of this date.

On the other hand, there is a lot of work to go on and I think the 4- or 5-year number is a reasonable estimate of the time at which this might become of practical significance.

Mr. FULTON. So that experimentally within a year and practically within 4 to 5 years on radio and television worldwide communications?

Dr. STEWART. The problems are the same in both. With the approach we are using, the same equipment applies to both problems.

Mr. FULTON. Will that come earlier than the worldwide television programs?

Dr. STEWART. The particular approach which we are taking here handles both of them in the same manner and one will come just as quickly as the other.

Mr. FULTON. All right. On hurricane and weather predicting, how soon will you have that for a 30-day period in advance?

Dr. STEWART. This is a very long-term problem. It may be a very long-term problem.

Mr. FULTON. All right. Will you tell me the time and then explain?

Dr. STEWART. I would say there is a very real question as to whether 30 days may ever happen. I taught meteorology for a number of years through World War II.

Mr. FULTON. I have just finished a course of it in the Navy. So I am curious——

Dr. STEWART. And we used to discuss with the students the problems of forecasting and we recognized then that one of the greatest deficiencies of forecasting came from the fact that we had no detailed knowledge of the outer structure of the earth's atmosphere and then in addition we had defective knowledge of much of the surface conditions.

Mr. FULTON. To clear it up, we have already had some forecasting, because we have found some incipient hurricanes forming and told the people about them. How quickly will you put into practical use what you have now?

Dr. STEWART. Again an initial experiment is scheduled for the Vanguard.

Mr. FULTON. When is that?

Dr. STEWART. Within the month, we hope.

Mr. FULTON. So that we will very quickly be putting into practical use experiments on weather forecasting, particularly with regard to hurricane development, is that right?

Dr. STEWART. But the problem——

Mr. FULTON. Just answer the question, please.

Dr. STEWART. Yes, this is right.

Mr. FULTON. All right. Man in space—when will the X–15 be in actual flight operation under its own operation and not just a drop? When is that scheduled for? Give me the time and then explain.

Dr. DRYDEN. The X–15 is always dropped from an airplane.

Mr. FULTON. I understand that. But it is going to be without power to begin with.

Dr. DRYDEN. The first power applied is March or April; I don't have the dates in mind.

Mr. FULTON. Would you put that in the record?

(The requested information is as follows:)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., February 20, 1959.

Hon. OVERTON BROOKS,
Chairman, House Committee on Science and Astronautics,
House Office Building, Washington, D.C.

DEAR MR. BROOKS: During the testimony given by personnel of the National Aeronautics and Space Administration before your committee, additional information was requested by Congressman Fulton on the X–15 flight schedule. The information answering these questions is as follows:

The tentative flight operation for the X–15 to be dropped without power is tentatively set for March 10; subsequently dependent on the satisfactory operation of previous tests, the first test of the X–15 for a power drop is tentatively set for April 1.

During the second day of the hearings, February 3, Congressman Fulton requested additional information with respect to NASA's budget and programs. That information has been collected and is enclosed herewith.

I want to express again my appreciation for the opportunity of informing the members of your committee of the program of the National Aeronautics and Space Administration and the progress made in connection with it.

Sincerely yours,

T. KEITH GLENNAN, *Administrator.*

Dr. DRYDEN. Yes.

Mr. FULTON. When is the drop without power?

Dr. DRYDEN. It is very shortly. It is scheduled very shortly.

Mr. FULTON. I understand it was scheduled for last Saturday. Has it been postponed?

Dr. DRYDEN. Yes, postponed for a time, yes.

Mr. FULTON. To what date?

Dr. DRYDEN. A couple of weeks, I don't remember exactly.

Mr. FULTON. All right. Will you put that in the record? All right. On man in orbit, what is the date you expect to put a man in orbit?

Dr. DRYDEN. When we are convinced we can get him back safely. It will be within a few years.

Mr. FULTON. All right. Give me the time, as a time. When do you program it? I am talking of your long-term programs, now, as to your timing.

Dr. DRYDEN. We program many orbital flights of the capsule. We will not at this time program the specific time when a man will go up there, because we must first be sure we can recover and locate the capsule, itself, with instruments, perhaps with animals, before we are willing to put a man in it. I cannot tell you when that will be.

Mr. FULTON. All right. The 6,000-pound payload you will have next year. Could the man be in there if you had these other things ready? Is that enough thrust to begin with and enough carrying capacity?

Dr. DRYDEN. We do not intend to wait for that. The booster in the first instance will be an Atlas booster.

Mr. FULTON. When do you expect to put a man on the moon in your long-range programs? Give me the date and then explain. By 1964, 1975, and could he be in the 2,000-pound payload to the moon, if other factors are favorable, by early 1961?

Dr. DRYDEN. 2,000 pounds to the moon and back would be very marginal to put a man in.

Mr. FULTON. So we really have to wait for the 10 tons of payload in orbit in 1962 and the 2 tons of payload in the deep space program?

Dr. DRYDEN. You will have to wait for probably 6 million pounds thrust to do this with assurance.

Mr. FULTON. Now, give me the date of that?

Dr. DRYDEN. 10 to 15 years.

Mr. FULTON. So that would be 1969——

Dr. DRYDEN. Before you venture onto the moon; yes.

Mr. FULTON. Before we attempt to put a man on the moon? Could you speed that up?

Dr. DRYDEN. We have a program which leads to this. There are many things that have to be done before you put a man on the moon, as you know.

Mr. FULTON. I am afraid if you get a man there, there is going to be someone already there, and if he asks if he can get on the moon, this man is going to say "Nyet" to him, he is not going to be able to get on.

Dr. DRYDEN. I don't think the problems are different anywhere in the world. We do have a program looking toward landings on the moon. We have not attempted to date this out month by month for 15 years. May I use an example? The very first satellite that we sent up discovered a new phenomenon in a world we never knew before,

the existence of a radiation belt which would give problems to man passing through it and to instruments used in it. We didn't know this before. This changes the whole aspect of the problem. Because if a man stays there very long, we must provide him with adequate shielding. Before we provide him with adequate shielding, we must know the composition of this radiation, how much of it is soft X-ray, how much hard. Now we expect as we go out into space we will discover other things, which must be taken into account before we send this man to the moon. I don't believe anyone can give you a certain date 15 years in the future.

Mr. FULTON. Thank you very much, all I wanted was target dates. That is all.

The CHAIRMAN. Thank you. I am going to call on Mr. Miller next, because I am going to ask him to go over to get permission for this committee to sit while the House is in session.

Mr. MILLER. No questions.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Dr. Glennan, in reference to this question of a race with Russia, shouldn't we have to take into consideration the fact that we are operating as a democracy while they are operating as an autocracy or dictator-type of government in which they can demand from their scientific team certain target dates for things that we can't do in this country in the same manner?

Dr. GLENNAN. I think this is true, Mr. McDonough. We do believe, however, that once started, we really can move faster than they.

Mr. MCDONOUGH. In other words, you are confident that we have the industrial capacity to produce the hardware once we write the specifications and know what we want?

Dr. GLENNAN. And the scientific talent to get on with the job.

Mr. MCDONOUGH. Could you inform the committee your schedule of probing shots, a variety of them, that you have scheduled for this year?

Dr. GLENNAN. We have scheduled about 40 sounding rocket probes that will go some distance into space for a variety of environmental measurements.

We will probably launch as many as a dozen satellites or space vehicles, space probes, in this calendar year, and there may be double that number in 1960.

Mr. MCDONOUGH. Now, what is the variety of the thrust used? Are these lightweight probes?

Dr. GLENNAN. These are all lightweight probes, using the boosters that are available to us at the present time, the Thor, and the Jupiter, and the Atlas in one or two instances.

Mr. MCDONOUGH. Did you learn enough from the lunar probe that we sent up to—what was the maximum, 89,000 miles?

Dr. GLENNAN. 71,300.

Mr. MCDONOUGH. Did we learn enough from that to be confident that the next shot will be successful? Was it a question of thrust or what was the failure?

Dr. GLENNAN. No. I think we learned a good bit from that experiment, and one always hopes that one can correct the things that went wrong. In this instance, as I recall it—well, I don't recall it very well.

Homer Joe, do you recall it?

Dr. STEWART. Yes.

The particular difficulty in the first probe was that the accuracy with which the rocket was held on course in its intial course in flight wasn't quite—it was off by about 3°.

Mr. MCDONOUGH. Was that a fault of the guidance system?

Dr. STEWART. It was a fault of the guidance system.

Mr. MCDONOUGH. In other words, do you believe with the next shot, with sufficient thrust, that you can orbit the moon and return to the earth?

Dr. STEWART. The most likely expectation is that it will pass in the neighborhood of the moon, if the equipment works properly. It will go into the neighborhood of the moon and go on into deeper space.

Mr. MCDONOUGH. Are we in position to anticipate orbiting the moon and the return to space of a satellite?

Dr. STEWART. Return to earth?

Mr. MCDONOUGH. Yes.

Dr. STEWART. That is a more difficult problem, and very likely will not be successfully accomplished. The first thing that we can expect to accomplish in this line is a flight similar to the one the Russians have just completed, going in the neighborhood of the moon and passing on into an orbit about the sun. That is the simplest deep-space mission to perform.

Mr. MCDONOUGH. Do you have any other manned space vehicle under consideration at the present time, beyond the Mercury that you have now under contract with McDonnell?

Dr. DRYDEN. There are wind-tunnel experiments and planning gong on with respect to the followup vehicle; yes, sr.

Mr. MCDONOUGH. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Teague.

Mr. Teague is gone.

Mr. Chenoweth?

He will be back at 2:30.

Mr. Anfuso?

Mr. ANFUSO. Mr. Glennan, to touch on a lighter subject, but nevertheless just as important, do you believe that the fullest exploration of outer space can make possible in the future a world of abundance so as to remove the basic causes of conflict and war?

In other words, what I am thinking of, for example, is this weather control. You probably can bring rain in desolate, dry areas and bring productivity there, isn't that correct? Isn't that all within the realm of future possibility?

Dr. GLENNAN. I think that our friends in the weather business would shudder a little bit at the use of the term "control." I think they might accede to modification. In this sense, yes, I think that one has a right to hope and probably to expect that there will come from this kind of activity benefits which would ease the tensions of the world.

Mr. ANFUSO. Now, in this exploration of outer space for both peaceful purposes and for the security of our country, do you think that we ought to get the cooperation of scientists from any country in the world, provided they meet a security check?

Dr. GLENNAN. I think we ought to cooperate with scientists the world over in this activity.

Mr. ANFUSO. I believe I have heard you say, and I think you said it in one of your speeches, that you believed in the free exchange of research information and the pooling of ideas wherever possible.

Dr. GLENNAN. This is the way science makes fastest progress.

Mr. ANFUSO. Now let me ask you this: Do you foreclose the possibility of working with the Russians?

Dr. GLENNAN. Not at all, sir.

Mr. ANFUSO. I would like to ask this question because Mr. Khrushchev made a very fantastic remark that he saw no angels in the heavens.

Do you see any challenge to God in this venture to outer space?

Dr. GLENNAN. No, sir.

Mr. ANFUSO. May I ask you why this McDonnell Aircraft Corp. of St. Louis was selected to design and produce the prototype of a capsule to carry man in this project?

Dr. GLENNAN. Under a very well-developed selection system in which we separate out the technical qualifications from the business qualifications of the competing concerns, boards of selection sat for as much as a week, as I recall it, in reviewing the various proposals made. They finally then reported to another board, which was to sit over them, and that board finally, to me, to Dr. Dryden, and the selection of McDonnell Aircraft came out of that process.

Mr. ANFUSO. Now, my final question, Dr. Glennan, is by way of making a statement and clarifying my own position on this committee.

I sincerely believe that the American people want to know the facts. I sincerely believe that the American people at the present time are not getting all of the facts. I sincerely believe that the American people are not realizing the danger that this country is in, the danger that this free world is in. And because I strongly believe in that, I believe that we must do somethiing to arouse the American people, and the best way I know of arousing the American people is by telling them in cold facts, "Yes, we are in danger of being destroyed. We are in danger of destroying New York Harbor. We are in danger of destroying the west coast. We are in danger of destroying the greater part of the wealth of America." And I believe that if you told that to the American people, the reaction would be so great that they would rather spend $10 billion in addition, now, than to have to spend $100 billion later on, which may get us nowhere.

Do you agree with me or do you not, Dr. Glennan?

Dr. GLENNAN. I would have to plead to that question that the information on which one bases one's evaluation of danger of the type that you mentioned is perhaps not wholly available to me. I think it is clear, however, that people only fear that which they don't know. Thus, I find myself in agreement with you that to the very greatest extent possible people ought to know facts.

I spoke a moment ago about the aspect of this organization of mine which is most precious to me, its integrity. I cannot compromise my own principles. If I don't know a fact, I can't tell it. I can give

estimates based upon information available to me, and I am quite willing to do this when I have enough data or facts on which to make an estimate. But otherwise I shall have to plead off. I still feel that fundamentally your statement is correct that people should know as much fact as we have.

Mr. ANFUSO. Would you agree with me, Dr. Glennan, that the paramount question of the day is not balancing the budget but rather getting this country on a safe path for the security, not only of this country, but for the entire free world?

Dr. GLENNAN. I am not in a political job, sir.

Mr. ANFUSO. We don't expect you to answer that question politically, sir.

Dr. GLENNAN. Well, I have always found that I have to pay my bills, and the day I don't pay my bills, I suffer some sort of a loss of standing in the community.

I think that in a time of prosperity, such as we are experiencing, one has to look at problems of balancing the budget. But I will never place my country in jeopardy in taking that look.

Mr. ANFUSO. In other words, if it was necessary to spend more money, to make our country secure, then you would overlook the idea of balancing the budget; you wouldn't classify that as the most important issue of the day?

Mr. MCDONOUGH. Will the gentleman yield to me?

Mr. ANFUSO. Yes.

Mr. MCDONOUGH. I think some of the questions you are asking Dr. Glennan could best be answered by the military men coming before the committee.

Dr. Glennan represents a civilian scientific organization. And the danger of destroying the west coast or New York Harbor is a responsibility of the Defense Department.

Mr. ANFUSO. I wasn't particularly referring to that. I was referring to the general picture.

Dr. Glennan is connected with a very important part of this whole picture, and I say this right now, gentlemen, that if need be, I am perfectly willing to vote more money, if that will make our country more secure than merely attempting to balance the budget.

Mr. FULTON. Would the gentleman yield?

Mr. ANFUSO. Yes; I will.

Mr. FULTON. I believe Dr. Glennan's field is the budget in his own agency. From what he has stated, it would seem that he would run a businesslike agency first. Secondly, I think the question is: Will you, if the public and country's security require it, come in and ask us for more money for programs which you have already evaluated and programed?

Dr. GLENNAN. On that you may be certain that I will.

Mr. FULTON. Thank you. That is all.

Mr. ANFUSO. I am satisfied with Dr. Glennan's statement before, that he places security above balancing the budget.

The CHAIRMAN. Now, gentlemen, it is past 12 o'clock.

Here is the program of the committee: We have a heavy schedule of witnesses today, and every day of this week through Thursday. We plan not to meet Friday, but to let the Members get away for a long weekend, if they wish to. We plan to meet in the afternoons

to finish up our daily list of witnesses. We plan to meet this afternoon at 2:30.

I would like to ask the witnesses, however, who have come this morning, will it be satisfactory that you return at 2:30? Can you make it back then?

Dr. GLENNAN. Yes.

The CHAIRMAN. At that time we will give every Member an opportunity to ask questions.

If there is no objection, we will adjourn until 2:30 this afternoon.

(Whereupon, at 12.13 p.m., the committee recessed, to reconvene at 2:30 p.m. of the same day.)

AFTERNOON SESSION

The committee met at 2:30 p.m. in open session in the caucus room, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will come to order.

Off the record.

(Discussion off the record.)

The CHAIRMAN. At the time we recessed we were calling the roll of those members that had questions they wished to ask. I think I had missed Mr. Teague of Texas. He told me he was leaving.

Mr. TEAGUE. Mr. Chairman, I would like to pass for awhile.

The CHAIRMAN. He passes for the time being.

Mr. Chenoweth?

Mr. CHENOWETH. Yes; I would like to ask some questions. Are you ready for me now?

The CHAIRMAN. Yes.

Mr. CHENOWETH. Dr. Glennan, as a new member of this committee, I wish to state I was very favorably impressed with your statement this morning and your appearance. I never had the pleasure of meeting you before. You are going into a realm which of course is entirely new to many of us on this committee, particularly those who are new members.

The people of this country of course are very much concerned and interested about this program.

Just what would you say we are seeking to accomplish now in this space program? We have lived on this planet for a number of years now pretty well, got along all right. What is it we are seeking to do out in space? What is to be accomplished? Is it a military objective? Is it something that is going to add to our own welfare and happiness at home, or is it just an experiment? Are we speculating as to just what is out there? Just what are we seeking to accomplish? I know you could express that in a few words much better than I can, and I know you know what I mean. I would appreciate just a brief statement from you.

Dr. GLENNAN. Yes, Mr. Chenoweth. Man has always sought information about the unknown and, basically, these explorations which we will undertake should return to us a great deal of knowledge about the cosmos, about the space about us, and ought to make possible the enlargement of our knowledge about our own world as we look at it from outside of the atmosphere. Whether or not the information which we obtain is used for destructive or constructive purposes is largely up to us as individual citizens in the expressions we make of our own wills.

Mr. CHENOWETH. There seems to be great stress laid on the fact that Russia is ahead of us; they are putting up something heavier than we are putting up.

Does that have any real significance so far as our security is concerned? Or is it just a matter of them perhaps having achieved something a little faster than we have, something perhaps they have worked harder at and perhaps have placed more emphasis on it. Is there anything that we should really be concerned about from a military or security standpoint?

Dr. GLENNAN. I think in the broad aspects of the national security which involve our posture, worldwide, our relationships with our friends or near friends, that any achievement which we may make becomes important in the maintenance of our national security. Whether or not this is a field in which tremendous values lie in a military sense, I think I would rather leave for the people from the Military Establishment to answer.

Mr. CHENOWETH. You don't care to go into the military aspects of it?

Dr. GLENNAN. No. I think they are better able to do this. This is a responsibility of theirs. What we are seeking in the way of information undoubtedly will be useful to them, as indeed we hope the results of some of their experiments will be helpful to us.

Mr. CHENOWETH. Now, then, there has been some stress laid upon the question of who is going to put a man on the moon first. What significance would that have, as to who put a man there first? Would it be of any particular value to either Russia or ourselves to do so?

Dr. GLENNAN. I think from the standpoint of national prestige it would have very substantial value.

From the standpoint of the scientific evidence or scienitfic information returned, it would have value.

Mr. CHENOWETH. I would like to ask the Doctor about the organization that you head.

I think you mentioned here in your statement that some 8,000 scientists, engineers, and supporting personnel were taken over from NACA.

Dr. GLENNAN. That is right.

Mr. CHENOWETH. Is that your staff at this time? Has that been augmented or increased in any way?

Dr. GLENNAN. No. We have augmented that staff somewhat.

As I recall it, our planned figure for the end of this fiscal year, June 30, is about 8,900.

Mr. CHENOWETH. How much?

Dr. GLENNAN. About 8,900.

Mr. CHENOWETH. Yes.

Dr. GLENNAN. And one must remember as well that we have acquired under contract now a staff of some 2,300 at the Jet Propulsion Laboratory, approximately half of whom are involved in—engaged on space projects at the present time.

Mr. CHENOWETH. Where is that laboratory?

Dr. GLENNAN. That is at Pasadena, Calif.

Mr. CHENOWETH. Pasadena.

While we are on that subject, Doctor, I would be very much interested, and I am sure other members of the committee, particularly those who are new on the committee, as to just where your operations are at this time.

This chart was prepared by you, was it? [Indicating.]

Dr. GLENNAN. Yes, sir, Mr. Congressman.

Mr. CHENOWETH. Would you just give us a brief summary?

Dr. GLENNAN. I would be glad to do this.

I believe it is planned that another member of the staff is to give you a complete briefing on that in a few moments.

Mr. CHENOWETH. I see. It would be all right if you would rather wait for him.

I think that is all the questions I will ask.

The CHAIRMAN. Mr. Osmers?

He is gone.

Mr. Sisk?

Mr. SISK. Mr. Chairman.

Dr. Glennan, I would like to direct a few questions here, which I would like to have Dr. Dryden, possibly, join in.

They go back to some of our past experiences.

I am sure, Dr. Dryden, you will recall the feeling of a great many in the development of the legislation to prepare for the new agency or to make it possible to have a new agency, that I had some concern, as others did, about whether or not we were simply changing the name of a group of people and dressing it up a little bit, but we would be doing business as usual, at the same old stand. I think you and I discussed that at that time.

Now, after having some months of experience in the new NASA, I would like both of you gentlemen's appraisal as to what progress you feel we have made from a comparative standpoint. Have we actually accelerated our program? Was the intent and objective of our establishment of the new agency, has it been achieved, or at least are we going in the direction of achieving that objective?

Dr. Glennan, first, if you would make some comments. I realize that is rather broad. But to me that becomes the important thing here.

Dr. GLENNAN. Mr. Sisk, as I understand the situation, and what you are after in setting up this law, I think we have made very great progress, actually, toward the objectives which you were hoping to attain. The development of a headquarters staff organization, capable of directing this program, I think, is well underway. We have been in business, as I think I indicated this morning, 4 months, I having been in Washington, myself, 5 months, as of the ninth of this month.

We have managed in this short period of time to develop the specifications for and select a contractor for and negotiate a contract and sign a contract for the development of the million-and-a-half-pound single-chamber rocket engine.

I believe this set somewhat of a record, as a matter of fact, in negotiating and placing under contract an activity of this kind which is to involve the expenditure of perhaps as much as $200 million before we are finished.

We have organized and got under way Project Mercury, under the very highest priority.

These are but two examples of the progress that I think has been made.

Now, it is a little self-serving in my sense to answer this question. I think that Dr. Dryden, who has been on both sides of this line of demarcation, October 1, last, perhaps can give you a different answer or a better one.

Mr. SISK. I might say that I appreciate your comments, Dr. Glennan.

I am glad to have an opportunity to hear your comments on it, Dr. Dryden, because, as head of NACA, where you did an outstanding job, and I know a lot of progress was achieved, I am curious as to your evaluation now as to what extent the new agency has enhanced our opportunities in this field.

Dr. DRYDEN. Yes, Mr. Sisk.

I am the first one to say that the NASA is a quite different organization from NACA in a number of respects, in the kind of work that we have to do, and the urgency with which we have to do it. The existence of NACA made it possible to start with a number of people from the NACA staff. Project Mercury was organized in speedy time because we could dip into the existing NACA staff of qualified people. We added to them some new people. We secured a detail from the services of experts in the aeromedical and space field who are located at Langley as members of this task-force group.

In other words, we did not wait for a permanent organization of the other side of the space agency; we started this project immediately.

Dr. Glennan has already referred to the million-pound rocket engine. We inherited a study contract. We held a competition, evaluated the results, and signed a contract, not a letter of intent, but the definite contract has been worked out and signed. This in very fast time. In a similar way, on Project Mercury a competition was held for the capsule, and this contract, which is in process of negotiation, will be signed very shortly.

The existence of the people in NACA, plus the existence of people in Vanguard, who were transferred, plus the very capable staff of the Jet Propulsion Laboratory, have enabled NASA to get off with a running start in the space development and operational projects which are a completely different activity from the supporting research and development carried on in the NASA research center. This program is being backed up in the research, of course, by the work done at the centers. In a similar way, on one of the high energy booster stages, a task force at the Lewis Laboratory was very quickly organized to back up the program in this field.

We also have been able to pool together teams to study the national booster program, teams on which people from defense were also participating.

We pooled together teams to study a coordinated plan for the additional tracking facilities needed for the programs that are coming up.

I feel that, being able to start with a pool of people, and with facilities, has very greatly accelerated the time in which we could get such a program moving.

One other remark: The bulk of our program is being carried forward by contracts or agreements with existing agencies. We have placed orders with ABMA for a considerable number of boosters. They will be responsible for doing engineering for us, and the firing of those boosters. In a similar way, we have made agreements and allotted funds to the Ballistic Missile Division, for projects which use the Thor and Atlas boosters.

And, in general, we are relying on contracting with existing organizations rather than building up a very great force of people within the Government, on the Government payroll. We are building up a large enough personnel to monitor these projects, to integrate them and direct them in a national program. But the carrying out of the program will be done by the resources of the country.

Mr. SISK. Then to sum up, Dr. Glennan and Dr. Dryden, you both feel, then, that much was accomplished in the establishment of the new agency and that it is, in essence, carrying out the objectives which were before us at that time?

Dr. GLENNAN. Yes, sir.

Mr. SISK. Now, Dr. Dryden mentioned that you were contracting with ABMA at the present time. I wanted to ask about your relationship with ABMA, and the overall operation at Redstone. Is that working successfully at the present time, in your opinion?

Dr. GLENNAN. Yes, I think it is, Mr. Sisk.

The orders which we have placed there for supporting activities, supporting certain of the space probes and the firings which will be necessary in the program of Project Mercury, are going very well, indeed.

Mr. SISK. The reason I asked that question, Dr. Glennan, is that I found myself in somewhat disagreement at the time discussions were underway about this transfer, which you recall, last fall. I had a little disagreement with my colleague from California. I was somewhat concerned about that, over the possibility of any interference with the Von Braun team. Of course I was very interested to learn, as I understand it, a satisfactory working arrangement has been worked out.

Now, I will go one step further: Do you feel that under the proposal which you made last fall that it could have been advantageous to NASA, over and beyond what the present relationship is?

Dr. GLENNAN. Yes, Mr. Sisk. I felt it at that time, I still feel it just that same way. But we believe, I believe, and my organization, I am sure, believes that we should not interfere with any of the Nation's missile programs and the Defense Department, Department of the Army, stated that they did have missile programs with which there would be interference were this transfer to be accomplished.

Under those circumstances they volunteered the fullest cooperation in undertaking particular tasks for us, and we agreed—I agreed that this was a reasonable solution of the situation at the time.

There is to be a review of the effectiveness of the operation within a year from the date of the signing of those documents which I recall as being December 3, last year.

Mr. SISK. Then along the same line, have you, so far, in the operation of your agency, developed any controversies or any overlapping jurisdiction where you feel it might cause substantial problems with reference to ARPA's operation? I am asking this in light of attempts, of course, to write into the enabling act, which set up your agency, provision for settling any of these types of controversies that might arise. I am curious to know whether they have been tested at the present time and if so how those provisions are standing up under the test of time.

Dr. GLENNAN. I say, Mr. Sisk, it has not been necessary to call into operation any of the provisions in the law. We have been able to sit down and discuss with the officials in ARPA and Mr. McElroy any of the problems which seemed worth discussing, where there was—I don't like to use the term "controversy," but let us say there was some difference of opinion as to the organization which should carry out this or that job.

Much of this, of course, was considered at the time of the preparation of our budgets, because we did coordinate our budgets so that these things did not appear as duplications and we were able without too much difficulty to allocate prime responsibility in every instance.

Some of those——

Mr. SISK. Let me ask you this, Dr. Glennan: As I understand, the X–15 program is under the jurisdiction of your agency, is that right?

Dr. GLENNAN. The technical direction of it is under NASA, and the research activities which will be undertaken with the X–15 will be under the direction of NASA, using both our own test pilots and some from the services.

Mr. SISK. As I recall the roll-out of the X–15 was last October. Which, by the way, I was happy to have an opportunity to observe. So far, what has been accomplished, if anything, with the X–15?

Dr. GLENNAN. The X–15 has not actually been flown, as yet. There have been test flights with the mothership, just testing the configuration that is necessary to carry the X–15 aloft.

The actual first drops, which will be unpowered drops, will take place within a 2-week period, as I recall it.

Dr. DRYDEN. May I just add, Mr. Sisk, that this time has been taken with ground testing of the systems, running the powerplant on the ground, the installation of instrumentation. In other words, the project has been moving forward in ways that do not appear on the surface, but are necessary before you put the machine into the air.

Mr. SISK. I have no criticism, Dr. Dryden, of the fact that it has not been flown. I was just curious about how that program was coming along. I have one other question in connection with that.

Now, primarily what do you hope to attain in the way of an objective in the overall space program from the X–15? I mean you must have one, two, three, or four objectives in mind.

Dr. DRYDEN. Yes.

Mr. SISK. As to how it can affect or how it can aid in, as I understand, the attempt to man a space vehicle?

Dr. DRYDEN. Yes. This was a research airplane to explore about three specific problems. In the first place let me say that this is a winged vehicle in which we hope to be able to control much more accurately than we can in Project Mercury the exact point of landing. In other words, it has wings so that there will be more control of the path after reentering the atmosphere. This airplane has a capability of pulling up steeply and sort of jumping out of the atmosphere to a fairly high altitude.

One of the problems which this will check out is the control of the attitude of the airplane, where there is no air to work on the usual aerodynamic surfaces. It is fitted with a reaction type control system which will be needed on all space vehicles, whatever their future character. So there will be some experience with piloting a machine in which the attitude is controlled by reaction controls.

Second, of course, it gives a period of weightlessness for man of 8 or 10 minutes, whereas heretofore we have only been able to get about 1 minute or this order by taking an airplane in a parabolic path so there will be somewhat longer experience of this unknown factor of weightlessness. The third and most important one will be the checking out of our techniques, dealing with the problem of aerodynamic heating.

It would be possible with this airplane to get into attitudes and situations where safe reentry is not possible. We must work within the flight envelop of this, to study the boundaries and conditions under which we can hope to get such an airplane back safely into the atmosphere. For this purpose, it is of course instrumented with a great many temperature measuring devices, with attitude measuring devices, so that the whole performance of the airplane is recorded on the ground.

These are the—I might include in the control problem the stability problem, because this is also involved.

The X–15 is really not a space vehicle, except in the sense that it can jump into space for a brief period and then reenter again.

Mr. SISK. Just one concluding question, and this has to do with quite a bit of the discussion, I might say, that has taken place this morning, and of course, quite a bit of the discussion that we hear and read about in the newspapers and on television and so on.

I do not know quite how to word this to get it over: I am interested in the relationship between our advancement in propulsion, thrust, as against our progress in fields that I might call payload. In other words, we are all concerned, of course, as has been indicated and is indicated every day, about the rapidity with which we are progressing.

Now, I think that certainly there is a relationship, that there is no point in being way ahead, in other words having a 6 million pounds thrust engine, unless we have something to put into it, or some useful purpose to put it to. Now I am curious to know as to the relative progress in the field of need for thrust as against our ability to produce the thrust?

Dr. DRYDEN. Yes. This is a problem, of course, with which we are very much concerned. At the present time the payloads are in the nature of scientific instruments. The heaviest scientific payload is perhaps a large telescope for astronomical purposes, which may be in the order of a ton or something more.

The really large payloads are needed as we go to much more difficult scientific machines, and, in particular, when we involve man in the process.

If I may illustrate this a little bit, the same cluster that we were talking about might put 10 tons or so in orbit, would put perhaps 1,700 pounds in soft landing on the moon. The more and more weight that you want to put far out into space, the bigger the booster you have to start with, because you have to lift the extra stages. You have to provide, in some cases, retrorockets to slow the vehicle down, to make it orbit about a planet.

In the case of the moon, a soft landing on the moon, we think it is not too early and we have some plans to start work on apparatus that you might put on the moon, what kind of measurements would you make on the surface of the moon. You have to have a payload that does something for you, analyzes the rock, sees what the atmosphere is there, shows you a picture back, or what not.

The development of such a payload is quite a complicated task. You can do a certain amount of testing of such a payload by dropping it out in New Mexico, perhaps, and trying these automated devices out.

Now when you come to include man, then you have all the problems of his sustenance, of landing him softly, getting him off again. These are the kinds of missions for which we need the very large payloads. In general, the ones which go to large distances in our solar system and the ones which involve man. These are the two—well, I might also mention communications.

In some of the more advanced communication satellites we will want a fair weight of complex apparatus, repeaters. We will have to deal with the supply of power that will last for a considerable time, because you do not want to have to replace this satellite every 6 months. This means the development of probably nuclear reactors as a source of the power, the devices for converting this into electrical energy to operate all the gadgetry in the payload. All of these things will take weight.

If you put a man in, I have already mentioned shielding which runs up the weight. These are the kinds of payloads for which we need much greater weight.

Mr. SISK. That, of course, was the point I had in mind, that there is certainly a relationship. Thrust alone is not the whole story.

Dr. DRYDEN. Not the whole story.

Mr. SISK. In other words, we have got to have some need for it and be able to put it to useful purposes or else just building a 10 million pound thrust engine wouldn't be worth a great deal unless we could recover something and we had the adequate type of payload to go along. That is all.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. No questions.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Dr. Glennan, first I would like to commend you on your attitude in your statement concerning our not underestimating the present progress and the potential progress of the Soviet Union in this field. I feel as you do, and I feel that both Doctors Stewart and Dryden—they have not stated it—but I think they reflect your attitude, as I do. I think it certainly would be dangerous for the American people and the Congress to underestimate at any time their potential.

Now, in line with—somewhat in line with the questions of Mr. Sisk, is there a priority project? Do you have a single priority, top priority project in existence at this time? Is thrust a prime project at this time?

Dr. GLENNAN. Project Mercury is really the project on which we lavish our top priority, and following that the million-and-a-half pound single-chamber rocket.

Mr. MITCHELL. That leads me to another question. You have mentioned the propulsion by a cluster of rockets. Now what is the peculiar advantage or particular advantage to the single-chamber type propulsion rather than the cluster?

Dr. GLENNAN. The ability to cluster it, finally, to get substantially larger thrusts.

The clustering today of the rocket engines available to us will give us propulsion in the neighborhood of 1 million to 1.5 million pounds of thrust. The single-chamber rocket will give us a million and a half pounds of thrust when it is fully developed. We cluster four of these and get 6 million pounds of thrust, and this is the type of thrust that will be needed when you send a man to the moon and get him back.

Mr. MITCHELL. Earlier today, I believe in our chairman's questioning, you stated that there was no—you are not in a crash program. And I have the same definition of a crash program as the chairman. I am not referring to a large amount of money being wasted. Do you have the money that you need?

Dr. GLENNAN. At the present state of our development I think we have the money to carry this program through on an urgent basis, which I take to be the basis which you really meant. And I have stated in the Senate hearings that if, as this program moves—and it is moving very rapidly—there appears to be a need for additional money, I shall have no hesitancy in going through the proper channels to ask for that money.

What I have said to you, of course, presumes that the Congress will approve the budget which was presented late last month.

Mr. MITCHELL. In line with that, Doctor, are there any projects that you—and I would like to have the comment of either of the other gentlemen, both to your right and left if they so see fit—are there any projects now that may be in the drawing-board stage that you feel should be be put into effect if you had the money today?

Dr. DRYDEN. Well, I cannot think of any one, again emphasizing that we received this approximately half a million dollars that is before the present Congress. We have provided for initiating the projects that we feel have reached this point of practical initiation.

Now, before the year is over I am sure that we will be moving on into others. As the program develops, each of these projects that we start is going to cost more than it is costing this year. The availability of money is a time phase thing. We have to believe that you gentlemen will supply the money as it is needed, as the program develops, rather than saying that we can put in the bank once and for all the amount necessary for the next 5 years.

Mr. MITCHELL. Then do I gather, Dr. Dryden, at this point you feel that there is no project that you need additional money for?

Dr. DRYDEN. I think that is a fair statement.

We of course are receiving proposals from very many sources for almost identically the same projects. This is what is happening all around.

We are trying to, and have, picked out—take Project Mercury, I think you will find a very general agreement among all contractors who studied it, that the quickest way to get a man into space is through the use of the so-called drag-type vehicle, that it would take much longer to develop a winged vehicle. Therefore we have taken Project Mercury, made this the highest priority, we went through a competition to select the design and carry forward.

Mr. MITCHELL. In submitting your budget did you eliminate any proposed projects that you felt might expedite this program?

Dr. DRYDEN. We certainly did not eliminate any that we had proposed. I think there have been—there are proposals from outside for a very great many projects. They differ very little in objectives from the objectives of the projects that we have initiated.

Mr. MITCHELL. Do you feel the same way, Dr. Stewart?

Dr. STEWART. Yes.

The CHAIRMAN. Mr. Baumhart?

Mr. BAUMHART. No questions.

The CHAIRMAN. Mr. Quigley? Mr. Bass? Mr. Hall?

Mr. HALL. Mr. Chairman.

Mr. Glennan, I am David Hall from North Carolina.

The President in his statement made the statement that each one of these vehicles cost approximately $35 million. I have seen reports from other sources that would lead me to believe that the cost of these vehicles did not come near that figure.

Now, has your agency or administration set up any means for the dissemination of information to the public?

Dr. GLENNAN. Oh, yes. We have a public information office, if that is what you mean.

Mr. HALL. Yes.

Dr. GLENNAN Yes, sir

Mr. HALL. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Riehlman?

Mr. RIEHLMAN. General—Doctor, rather, Glennan. I am used to talking to military so often that I forget we have civilians before us on the committee.

I am vitally interested to know what arrangements you have with the three military services to coordinate this whole effort that we are vitally interested in?

Dr. GLENNAN. There is provided in the law a committee known as the Civilian-Military Liaison Committee, which is chaired by Mr. William Holaday, on which sit four members of staff. These are our top staff. Dr. Silverstein, Dr. Dryden, Mr. Stewart, Mr. Abbott. Mr. Hyatt is an alternate. And a representative from each of the armed services and from the Secretary's Office, also.

This Committee meets upon the call of the Chairman and they will provide a channel for interchange of information. But this isn't all.

We have established 13 committees which are advisory to NASA in a variety of fields, technical fields. Here again military members sit on those committees, as well as representatives of educational institutions and industrial companies.

Finally, at all levels through the organization, the working levels in these programs, our people are interchanging daily information on the programs.

Mr. RIEHLMAN. Do you feel that you are getting a free flow of information from the military side as to their progress?

Dr. GLENNAN. Yes, sir.

Mr. RIEHLMAN. And the military side is getting complete information from your organization as to what your scientists are developing?

Dr. GLENNAN. We are trying to; yes.

Mr. RIEHLMAN. And that there is no particular duplication of activity?

Dr. GLENNAN. I think that there is no particular duplication of activity which we have not agreed to be useful duplication.

Mr. RIEHLMAN. Does your organization have any direction at all over the military's activities in its research and development program?

Dr. GLENNAN. Not direction over them. They do carry out some of our research and development activities under our contract or under our technical direction.

Mr. RIEHLMAN. Your activities have not interfered in any way with the three military services?

Dr. GLENNAN. No, sir.

Mr. RIEHLMAN. And their activity.

Now, in respect to some of the questioning carried on by my colleague, Mr. Sisk from California, which is of terrific importance, that is the construction of engines to give us the thrust to put a payload into orbit. Naturally that is true when you are looking at it from your side and your activity, and that is for the welfare of humanity, that is where the big payload apparently comes in.

Now, is it not true that that is not as important when we come to thinking on the military side, if you would like to express your views one it, in carrying a payload of destructive power?

Dr. DRYDEN. The primary interest in the million and a half pound engine is for the space projects. We do recognize that this engine may find military applications, in military space projects. For that reason we have requested and there has been assigned to our organization an Air Force officer who will work with us in the direction of that project, to see that any military requirements are incorporated in the program.

Mr. RIEHLMAN. One other question, Dr. Glennan: You have some-

thing over 10,000 people under your Administration's activities. Where are they located throughout the United States?

Dr. GLENNAN. Mr. Siepert, of our staff, is going to give you a brief statement on the location of our particular organizations. But you will find them in California, in Ohio, in Virginia, and in—yes; I think those are the three principal locations.

Mr. RIEHLMAN. All right. Thank you very much.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Mr. Chairman, Dr. Glennan, I am Leonard Wolf, of Iowa. Right or wrong, some people are saying what the Russian Communists really have in mind is to get us so wrapped up in this conquest of outer space that we are letting our national security lag. I am wondering if you might have an opinion on this at this time?

Dr. GLENNAN. I think I have said earlier——

Mr. WOLF. You have discussed it, I know.

Dr. GLENNAN. Yes. That we were attempting to be very careful to avoid interference with military programs, particularly in our discussions about the ABMA situation.

Mr. WOLF. You don't think there is any danger of part of our military security budget, then, being diverted to the space agency, in this question of the balanced budget?

Dr. GLENNAN. I think not.

Mr. WOLF. All right. The other question I would like to ask: You suggested that you have an education agency. Does your agency feel, in other words, to tell your story to the people, does your educational agency feel that the right story is being told to the people, or is this thing being glorified and glamorized out of its true proportion?

Dr. GLENNAN. Our NASA Public Information Office is under very strong compulsion, particularly from me, to make certain that what is being given to the public is factual information, it is not blown up and made a ballyhoo.

Mr. WOLF. Apparently I didn't make myself clear. I realize you are giving them the information you want to give them with all due respect to the press, but are they getting all that they should have?

Dr. GLENNAN. Through our organization, I think so; yes.

Mr. WOLF. The last question I have to ask has to do with Radio Free Europe and Voice of America broadcasts: Are we attempting through our broadcasting agency to tell these people behind the Iron Curtain of our accomplishments?

Dr. GLENNAN. Yes, sir; the United States Information Agency is working very closely with us on matters of that kind.

Mr. WOLF. I realize the Russian propaganda agencies are working in reverse. I realize the Communist agencies are working very hard to try and portray us as conquering space as a military thing and it is blown up out of its true proportion. I wonder if this is being done?

Dr. GLENNAN. I think we are working that out. USIA has a man detailed in our Public Information Office for just this purpose.

The CHAIRMAN. Mr. Karth?

Mr. KARTH. Mr. Chairman, Doctor, I am Joe Karth, from Minnesota. I have a question. I was a little surprised this morning in

answer to a question by the gentleman from New York, Mr. Anfuso. He asked you whether or not in your opinion, if there was a greater amount of money spent, whether you felt this whole program in the field of space could be speeded up. If I recall correctly your answer was that you did not think so, you felt that it would create a paralleling program or paralleling programs, and that it would lead to, oh, giving some insurance for accuracy or correctiveness, rather than speeding it up. Is this your opinion, sir?

Dr. GLENNAN. At the present state of the art, that is my opinion; yes, sir.

Mr. KARTH. The reason I ask is because I find this quite different from the old concept that we have been led to believe, and accept as being true, in the theory of economics. I have always been of the opinion that competitiveness, for example, breeds creativeness, and that it motivates, shall we say, technological advancement—that it breeds inventiveness.

And so it seemed to me that if more money were spent, probably allowing for competitive parallel agencies, that this would, to some degree, advance and speed up quite considerably—depending upon the degree, of course, it was entered into—the answers to the questions, which we apparently do not have at the moment.

Dr. GLENNAN. We do have competition in some areas of our activity. Competition for the development of payloads, competition in certain areas of research where we do pursue parallel courses. We believe in competition, but I think the manner in which I took the question, at least, was: Can you really make a great deal more speed if you spend a great deal more money? Was that what you had in mind?

Mr. KARTH. As I understand it; yes.

Dr. GLENNAN. And my answer was that I did not think, with the present state of the art, that we would make a great deal more speed, that we would shorten the time scale very much, but that undoubtedly, if we did have a lot more money, we would initiate parallel programs which, if one failed, the other might have a chance of success, so that indeed we were then buying insurance at substantial cost.

Dr. DRYDEN. May I amplify this a little? I think in most of our previous discussions we have been thinking about major projects rather than the underlying research. We do propose to put more money into the research underlying advances into space, and to work in connection with electrical propulsion systems and to perhaps get more people interested in celestial mechanics, in some of the basic side of communication problems.

I think in this area we do want to get a lot of people working, but when we come to the major projects which cost several hundreds of millions of dollars, we do not see that putting another $2 million in a parallel project will really reduce the time.

Mr. KARTH. Doctor, one more question, please, in this same vein: If a paralleling agency could, on occasion, improve on the accuracy or eliminate mistakes, because we are delving in a field with so many unknowns in it, even the finding out, shall we say, or the discovery of a mistake, one particular mistake in this tremendous field of unknowns, couldn't that on occasion save you actually months and months of time?

Dr. DRYDEN. Yes. But I think we get this sort of thing in the elements that go to make up this major project. There will be many approaches to the heating problem, to materials problems, to research on combustion, and it is up to us, who are managing the project, to see that all of this information is brought into the agency carrying on the development.

But we do not see that a parallel complete engine development would necessarily reduce the time.

Mr. KARTH. Then you feel that the paralleling projects that have been entered into by the military services, for example, have been of no material value?

Dr. DRYDEN. I don't know of any paralleling projects.

Mr. KARTH. Haven't the military on occasions been all interested in the same project and one has come out with it substantially sooner than the other?

Dr. DRYDEN. You are thinking of other areas.

Mr. KARTH. Yes, sir.

Dr. DRYDEN. For example, where there may be three or four airplanes developed to meet the same requirement.

Mr. KARTH. Yes. Do you feel that this competitiveness on the part of the military has substantially led to a better airplane much sooner, much faster for the U.S. security, than we would have had, had there been no competitiveness between the military?

Dr. DRYDEN. I think it is very difficult to answer this question in compelte detail. I think it has given the opportunity to pick out the best of two or three designs, but I think that attention paid to the perfection of one design has paid off.

May I go back to the days of NACA? Our philosophy was that we would furnish all the information we could to all of the people who were entering the competition. After one of them had been selected or two of them had been selected, the job was to make that entry just as good as one could possibly make it by putting in all the resources that we had and other people had into the project.

I am not sure that the airplanes were gotten quicker by having several of them going at once. You can argue that you had the chance to pick the best two or three.

Mr. KARTH. Thank you.

The CHAIRMAN. Dr. Hechler?

Mr. HECHLER. Thank you, Mr. Chairman.

Dr. Glennan, I want to commend you for the statement that you made this morning on the freedom of scientific inquiry. I thought it was beautifully put.

Now this is the question I would like to ask you: In a very broad way and without getting into specifics, would you evaluate the usefulness of material which NASA is able to glean from Russian scientific journals?

Dr. GLENNAN. I think, if I may, I would ask Dr. Stewart, who has been quite close to this sort of thing, to give you an opinion on that.

Dr. STEWART. In some ways it is a little early to really give a definitive answer to this question.

The Russians, and ourselves, have agreed under the IGY program, for example, to have a complete exchange of the scientific information gained in the satellite launching programs.

In both our program and theirs, large quantities of information have been obtained and they have released some of it and we have released some of ours. It is factually true that neither of us have yet had time to release all of the information.

The information I have seen from the Russian work is good, good quality information. I know my friends that attended the last meeting in Russia in August or September, I have forgotten which it was, felt that the exchange of information was valuable and worthwhile.

Mr. HECHLER. Here is what I am getting at in asking my question: How do you feel about the scope and intensity of the review we are doing on Russian journals? Do you believe that we have adequate translation facilities and is the information of sufficient value so that we should step up such a program?

Dr. STEWART. There are new people doing these things every few months.

We do not yet have the capacity so that these Russian informations are translated and evaluated within a matter of weeks. But on the other hand they are generally available within a matter of months. We are doing fairly well in this problem.

Dr. GLENNAN. I would like to add to that answer if I may. I was very pleased in this field to see the President about 6 weeks ago, as I recall it, maybe 8 weeks ago, accept a proposal made to him by the Science Advisory Committee to enlarge our activities under the leadership of the National Science Foundation, indeed to provide in the budget some money to see to it that this coordination was undertaken and I believe that we are moving rather rapidly, as a matter of fact, into the field of enlarging and increasing our ability to translate and disseminate that information rapidly.

Mr. HECHLER. Thank you, Dr. Glennan. I am sure that this committee would be interested in hearing of any handicaps that you might suffer in securing information from Russian scientific journals in order to aid the progress of your work.

Dr. GLENNAN. Thank you, sir.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Dr. Glennan, in the eighth page of your report, your prepared statement, you refer to asking the Army to transfer a portion of the Army Ballistic Missile Agency at Huntsville to your program. Then you say that this would provide the necessary ground testing and assembly capability.

Now what have you done to replace this type of program since the Army did not allow you to take that under your wing?

Dr. GLENNAN. We have not done anything as of the present time. This decision was entered into on December 3 of last year, and we are attempting to determine whether or not the use of such facilities under contract is a feasible thing to do.

Mr. DADDARIO. Well, you also, in that same paragraph referred to this, you say, "Such a transfer would give us an imaginative, competent engineering and design group capable of serving in the planning and executing—". What have you done to fill in that gap of imagina-

tive, competent engineering personnel since that was not given to you by the Army?

Dr. GLENNAN. At the present time we are using people from our own staff and have not really moved into the area of developing a parallel organization. We are working with the ABMA people in the hope that we can get assistance that will be valuable to us in this area. But it isn't quite the same as having on your own staff, part of your own team, a group of people that are participating in the development of the total program of the agency.

Now we have to come to a decision on this matter within the next few months, as to which way we are going.

Mr. DADDARIO. Well in the last part of your statement you referred—you used three words as being those needed to build up your program, you say time, effort, and money.

Dr. GLENNAN. Yes.

Mr. DADDARIO. Would it appear that there should be another word added "cooperation"?

Dr. GLENNAN. I think we have reasonable cooperation at the present time, sir.

Mr. DADDARIO. Well then——

Dr. GLENNAN. I think your suggestion is——

Dr. DRYDEN. May I add just one detail to sharpen this up a little bit?

Mr. DADDARIO. Certainly.

Dr. DRYDEN. What we are doing is this, when we have a program which involves Jupiter, we can use the facilities of ABMA with this function. We cannot use those same people to do the same thing if it happens to be Thor or Atlas. We then use the facilities of the Ballistic Missiles Division. Neither one of these agencies are a part of NASA. Therefore, some people on our staff have to ride herd on these groups to see that what they do is consistent with the overall program.

In other words, we are meeting this function by contracting with some more limited supervision from members of the NASA staff. Now what we would like to obtain is a group within NASA who would deal with all of these programs in the same little group, regardless of what the particular booster happened to be.

Mr. DADDARIO. Would you feel that this has accelerated your program in the same fashion that it would have if this request had been acceded to? Are you as far ahead now as you would have been if this had been placed within the scope of your own program?

Dr. DRYDEN. I think we, timewise, are as far ahead. The problem is one of integration. The problem is: Can we use a contractor to an agency to supervise the execution of the contract? This is the problem, you see.

Mr. DADDARIO. Well, in both of these positions you use the word "necessary". Then the Department of Defense decided that its Army Ballistic Missiles Agency special talents were necessary to them. Who decided which of these two necessities took priority or which necessity became unnecessary?

Dr. GLENNAN. Our agency believes that the missile program should take priority over the space program. Thus, the determination on the part of the Secretary of Defense that the facilities, capabilities of

ABMA should be retained in the missile program, seemed to us to be conclusive. We do not have means of determining for ourselves, nor would it have been our business.

Mr. DADDARIO. Do you believe, even though it is too early to say, that this arrangement will be adequate, that you will be able to carry out your own capabilities——

Dr. GLENNAN. Sir, we have to.

Mr. DADDARIO. With this cooperative type of program, rather than setting up one of your own?

Dr. GLENNAN. It is too early to say. We have to keep this under continual scrutiny. We must not let anything stand in the way of our moving ahead just as fast as we can, other than interference with a missile program.

Mr. DADDARIO. And this decision will not be made for a year; is that correct?

Dr. GLENNAN. We are to come back to the President and the Space Council within a year to report on the extensiveness of the success of this collaboration and cooperation and with any other proposals that may be necessary. Should I find it necessary before that time to again raise this question, you may be certain I will.

Mr. DADDARIO. If you feel that within the year that this should be done, then you will speak up.

Dr. GLENNAN. I will, sir.

The CHAIRMAN. Mr. Moeller?

Mr. MOELLER. Yes, Mr. Chairman.

Dr. Glennan, turning briefly from the technical and the administrative side of this, this morning you were asked a question by the colleague from New York, I think, whether or not you felt that the program as you have it projected here might invoke the displeasure of Almighty God or in defiance of God's will, to which you, in my opinion, rightly, answered "No."

However, I notice on page 4, the last paragraph, in fact, line 24 of that page, you speak of some of the objectives or some of the goals or the aims, and you inject the spiritual, the satisfaction of the spiritual. Would you be inclined to elaborate on that for just a moment, please? I must protect my professional colleagues here, too.

Dr. GLENNAN. I understand, sir. I think in this sense, that I am speaking of the releasing of man from any bondage here on earth, that he is a creature with a mind of his own and instead of just worrying about, "Can we have a man flying around in space?" What we are trying to do, it seems to me, and what will be the great gain of this program, will be the release of man from another set of fetters, his being bound to terra firma here.

Mr. MOELLER. I didn't get that last statement.

Dr. GLENNAN. His being bound to the earth, to the ground, as it were.

Mr. MOELLER. Well, there is then the probability that through your operation here we might develop a new system of philosophy, maybe, a new system of theology, could all of this come out of this, too?

Dr. GLENNAN. I don't believe I am competent to comment on that, sir.

Mr. McDonough. Will the gentleman yield to me at that point?

Mr. Moeller. Yes.

Mr. McDonough. There have been observations made by the top theologians of the world, and I have read the opinions of many of them, that the searching for this additional scientific information in the universe is an obligation of mankind, and it is not by any means a violation of the fundamental dogma of any religious belief.

Mr. Anfuso. Would you yield to me? I might add to that, that Pope Pius the 12th, last year, issued a similar proclamation.

Mr. McDonough. And similar expressions have been made by other leaders of church groups and great theologians.

Mr. Moeller. To that, Mr. Chairman, I would like to add this: I think there is, in the realm of possibility here, much to add to the strength and the conviction that religion already holds with respect to some of the areas of which the church, Christianity in particular, speaks about. So I am looking forward to the day when you are going to bring further information that we will be using in years to come.

Mr. McDonough. Will the gentleman yield further. I think this is a contradiction of the statement that was made and referred to this morning by one of the members, that Khrushchev sent his satellite into orbit beyond the moon and they didn't find any angels up there.

The Chairman. Well, if you ask me, I don't think Khrushchev or any of those Communists were looking for angels.

Mr. King?

Mr. King. Dr. Glennan, I am David King from the Second District of Utah.

A few days ago Dr. Levitt of the Fels Planetarium, as I recall, is quoted as having said in a national press release that within 20 years it would not be too much to imagine that we may not only have reached the moon, but we might be living there, transplanting segments of our society and existing under a large plastic dome, and grinding up rock and other materials to be found on the moon to create atmosphere, water, and so on and so on?

Would you care to comment on that?

Dr. Glennan. I leave this to my scientific colleagues.

Dr. Dryden. Well, I mentioned before, that the landing of man on the moon is forecast somewhere 10 to 15 years from now. I think that Mr. Levitt, whom I know very well, is letting his imagination roam somewhat very far into the future.

I don't think we have enough information about the chemical composition of the moon to know whether it is feasible to set up an economy there independent of materials supplied from earth.

I think that the first travelers to the moon are going to have to depend on their—make sure that they take the oxygen and water and food that they need from earth, that they have a system of resupply.

As we know more about what is on the moon, it may be possible to work out procedures for living off the land, so to speak. But I don't think we have enough knowledge now. We know so little about the surface of the moon and its chemical composition. There is no trouble building vacuum chambers, no trouble with air conditioning on the moon, I think, provided we have sources of energy. But

whether we can depend on the local sources of chemicals and power and so on, we just don't know at the present time.

Mr. KING. Then you are saying at least it is conceivable?

Dr. DRYDEN. It is conceivable.

Mr. KING. That within the foreseeable future there might be colonization on the moon in sufficient quantities that it would have some practical impact on our own economy and our own sociological problems, rather than just as a novelty?

Dr. DRYDEN. I don't know how we can tell. If we look back to the time that Jules Verne wrote his books, they, of course, were pure fiction. Now we think he was a wise forecaster; he knew what was coming. It may be that Mr. Levitt is quite as competent of looking into the future and predicting as Jules Verne was. But I think the reasoning is on the same basis as Jules Verne wrote his story. They are the enlightened imagination of a man trying to figure out how certain problems would be solved.

Mr. KING. Thank you. I am quite interested in our educational preparation and background for this great challenge that you have been telling us about today.

I would be interested in knowing whether you feel that your program has been handicapped in any way by a lack of available scientists, of such depth and preparation and scholarship and aptitude and so on, that can step into this program and fulfill their function? Or, on the other hand, do you feel that there may be a basic lack in the training that our young people are being given and that you feel the impact of that lack when they step into your program?

Dr. GLENNAN. I think it is reasonable to say that we haven't felt any real difficulty as yet. But looking years ahead, I am not so certain. The important activities of this country in the next 20 years are going to involve more and more scientists and technologists in almost every field. And I doubt very much—as you know, I spent some time in the educational field—I doubt very much that we are paying as much attention to the development of well-trained scientists and technologists and, indeed, specialists in every field, as we should in this country.

Mr. KING. You would look with favor, I take it, then, in a renewed emphasis on the scientific program as we have heard so much about in recent months?

Dr. GLENNAN. I would.

Mr. KING. Thank you.

The CHAIRMAN. Mr. Roush?

Mr. ROUSH. Mr. Glennan, I am Ed Roush from the State of Indiana.

Mr. King here took my question, but I want to pursue it one step further. It seems that we must have an emphasis right now on our present program, and in the course of my reading over the weekend I read in one of these many reports that have come across my desk where there are many scientists outside of this country who can do nothing more than theorize and think about these problems, because their own country, because of its economic conditions, cannot permit them to build the hardware and to perform the necessary experiments.

I am wondering if there is anything in our program at the present time to utilize the talents of these great scientists of the free world.

Dr. GLENNAN. We have set up an Office of International Cooperation and are in the process of staffing that office, having already brought on board a director. We hope to engage in that kind of activity and bring into our program both in their own countries and by bringing some of those people over to this country, and enlarge the number of scientists that are active with us, particularly to bring some of the foremost scientists effectively into the program.

Mr. ROUSH. Going back to a question which was asked of you many times this morning along the same line: When will it be that we will be able to bring those scientists to America and utilize those talents? How soon?

Dr. GLENNAN. I hope that we will have before this year is out more than one international cooperative program.

Mr. ROUSH. Thank you, sir.

Mr. WOLF. Dr. Glennan, I asked about this question of education before. You told me that you have a committee or commission or some other agency that handles these things——

The CHAIRMAN. Gentlemen, I will say this in response to Mr. Osmers there: He asked to be called on. We do have—I don't want to rush anybody, but we have five more witnesses this afternoon.

Mr. KARTH. This calls for a yes or no answer.

Mr. WOLF. This calls for a yes or no answer.

The CHAIRMAN. We are going to let you go ahead. In the future I suggest that as we call the turn, the members get into their questions quickly. We will continue until 5 o'clock this afternoon, and everybody will get a chance.

You have a question?

Mr. WOLF. Is your education agency working with the high schools and the colleges to kind of demonstrate to them, to help them to better prepare themselves to step into the space field?

Dr. GLENNAN. This, sir, is a problem that the National Science Foundation is covering rather well. We, ourselves, have not entered into this activity. We really haven't had much more than enough time to get the office reasonably well organized.

Mr. WOLF. Thank you.

Mr. ROUSH. I have no further questions.

The CHAIRMAN. Mr. Osmers, we missed you in the first go-around.

Mr. OSMERS. Mr. Chairman, I will not ask Dr. Glennan my customary question about what will happen if the moon shoots back. [Laughter.]

However, I wanted to go right to the subject of education. It was 5 years ago this month that I introduced a bill in Congress providing for scientific scholarships, which was ignored and scoffed at by educators and Congressmen alike.

I want to ask you a question that seems quite appropriate: On the first day of the hearings of this committee we are in a "Wright brothers" era, at the moment, as far as space is concerned, and several of the latter questions here have pecked away at the subject.

I would like to ask you whether in your opinion, Dr. Glennan, or Dr. Dryden, does the United States at the primary, secondary, and university level, have a scientific education program sufficient to meet the needs of the Nation?

Dr. GLENNAN. My answer is "No."

Dr. DRYDEN. Same.

Mr. OSMERS. That is my only question, Mr. Chairman.

The CHAIRMAN. Now, Mr. Ducander, do you have any questions?

Mr. DUCANDER. Mr. Chairman, in the interest of getting along I think I ought to waive these questions. We have so many—you only read the witnesses on the first page there.

The CHAIRMAN. Oh, I read five on the first page and I quit. But that is true, there are two on the second page. We had better plan on running a little longer than 5 o'clock.

Do you have a question?

Mr. FULTON. Yes.

In the case of the exploration of the moon or other heavenly bodies, Dr. York said to us:

> In the case of the Moon, a manned exploration could take place in just about 10 years (perhaps in as little as 7, if a very high priority were placed on this goal). In the case of Mars and/or Venus, manned exploration will not take place until a few years after 1968 (but could perhaps be done in just about 10 years if a very high priority were placed on this goal).

Will you correlate to me your statements that it would take 10 to 15 years to get to the Moon with Dr. York's statement that we would shortly after 10 years be on even Mars or Venus?

Dr. DRYDEN. This is a case where honest men differ.

I think in the publication put out by the committee, Dr. York's estimate is the lowest of any in there. There were others who estimate longer than the time that I gave.

Mr. FULTON. How much money would you need to get us on a program that would make us even with Russia on our space program, and probably leapfrog them in these various fields?

You see, my point is this: I want to be the firstest with the mostest in space, and I just don't want to wait for years. How much money do we need to do it?

I might say to you further, when you were before us, Dr. Dryden, on August of last year, I was one who said let's get along with these programs. In fact, Jerry Ford and Mr. McDonough had spoken then too about the necessity of getting moving on the programs, and we thought you would immediately come here for more money from us as of January 7, didn't we, Mr. McDonough? And there has been no request yet.

Dr. DRYDEN. Yes, there is a request——

Mr. FULTON. Likewise, I understand you haven't even programed all your present budget. You have $200 million not even programed.

Dr. DRYDEN. There is a request before you for $50 million supplemental.

Mr. FULTON. But isn't there $200 million that you haven't yet programed or planned on your current budget?

Dr. DRYDEN. I know that we have programed—we have obligated something more than $200 million in 4 months. And I think that this is a fairly fast rate of obligation.

Mr. FULTON. Out of $408 million?

Dr. DRYDEN. Out of $300 million.

Mr. FULTON. Isn't the total——

Dr. GLENNAN. That is next year's budget.

Dr. DRYDEN. You are talking about next year's budget.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Summary, research and development programs, fiscal year 1959

[In millions of dollars]

NASA total	Allotments	Obligations		Unobligated balance	Pending commitments	Uncommitted balance	Expenditures		Unexpended balance
		1959	Total				1959	Total	
Aircraft, missile, and spacecraft research:									
Support of NASA plant	0.39	0.28	0.28	0.11	0.02	0.09	0.16	0.16	0.23
Support of JPL plant	8.16	8.16	8.16				.60	.60	7.56
Research contracts	5.50	.11	.11	5.39		5.39			5.50
Scientific investigations in space:									
Sounding rockets	5.00	1.90	1.90	3.10	1.12	1.98			5.00
Earth satellites	43.95	21.15	21.15	22.80	3.52	19.28			43.95
Lunar probes	20.02	4.35	4.35	15.67	2.50	13.17			20.02
Deep-space probes	16.00	10.84	10.84	5.16	3.55	1.61	.40	.40	15.60
Vanguard division	25.54	23.80	23.80	1.74	.07	1.67	1.04	1.04	24.50
Satellite applications investigations:									
Meteorology	3.40			3.40	1.15	2.25			3.40
Communications	4.70	2.16	2.16	2.54	1.00	1.54			4.70
Space operations technology:									
Manned space flight	37.66	17.38	17.38	20.28	11.24	9.04			37.66
Space rendezvous techniques									
Space propulsion technology:									
Solid-fuel rockets	.70			.70		.70			.70
High-energy-fuel rockets	7.00	3.03	3.03	3.97	.23	3.74	.06	.06	6.94
1,000,000-pound-thrust single-chamber engine	12.00	12.00	12.00						12.00
Nuclear rocket engines	8.50	1.90	1.90	6.60		6.60			8.50
Space engines	.30			.30		.30			.30
Auxiliary power units	.50			.50		.50			.50
Space systems technology:									
Advanced vehicle systems	.50			.50		.50			.50
Booster recovery systems	.50			.50		.50			.50
Orbiting space laboratories									
Supporting activities: Tracking and data acquisition	4.30	.87	.87	3.43	.47	2.96	.02	.02	4.28
Total, research and development	204.62	107.93	107.93	96.69	[1] 24.87	71.82	[2] 2.28	2.28	202.34

[1] Plus $9,460,000 since Jan. 31, 1959.
[2] Estimated total, fiscal year 1959, $52,000,000.

Appropriation summary, fiscal years 1959 and 1960

	Fiscal year 1959				Fiscal year 1960, regular estimates
	Appropriated			Supplemental estimates	
	NACA	NASA	Total		
Salaries and expenses	$78,100,000	$5,000,000	$83,100,000	$3,354,000	$94,430,000
Research and development		50,000,000	50,000,000	20,750,000	333,070,000
Construction and equipment	23,000,000	25,000,000	48,000,000	24,250,000	57,800,000
Total appropriations	101,100,000	80,000,000	181,100,000	48,354,000	485,300,000
Transfers from Department of Defense			154,619,532		
Air Force $57,800,000					
ARPA 67,200,000					
Navy (Vanguard) 25,541,282					
Army (JPL) 4,078,250					
Total obligational authority			335,719,532	48,354,000	485,300,000

Research and development programs, fiscal years 1959 and 1960

Page No.	Program	Fiscal year 1959		Fiscal year 1960 regular etsimate
		Allotments	Supplemental estimates	
	Aircraft, missile, and spacecraft research:			
205	Support of NASA plant	$338,800		$16,670,000
226	Support of JPL plant	8,156,500		8,156,500
230	Research contracts	5,500,000		8,200,000
	Scientific investigations in space:			
232	Sounding rockets	5,000,000		10,000,000
235	Earth satellites	44,000,000		61,800,000
238	Lunar probes	20,021,750		24,043,500
242	Deep-space probes	16,000,000		22,500,000
245	Vanguard program	25,541,282		
	Satellite applications investigations:			
250	Meteorology	3,400,000		15,000,000
253	Communications	4,700,000		13,000,000
	Space operations technology:			
256	Manned space flight	37,661,200	$20,750,000	70,000,000
260	Space rendezvous techniques			3,000,000
	Space propulsion technology:			
262	Solid-fuel rockets	700,000		3,000,000
264	High-energy-fuel rockets	7,000,000		17,000,000
266	1,000,000-pound-thrust single-chamber engine	12,000,000		30,200,000
268	Nuclear rocket engines	8,500,000		8,000,000
271	Space engines	300,000		3,000,000
274	Auxiliary power units	500,000		3,000,000
	Space systems technology:			
277	Advanced vehicle systems	500,000		1,500,000
279	Booster recovery systems	500,000		1,500,000
281	Orbiting space laboratories			2,000,000
284	Supporting activities: Tracking and data acquisition	4,300,000		11,500,000
	Total, research and development	204,619,532	20,750,000	333,070,000

National Aeronautics and Space Administration programs and duration

Program	*Duration*
Sounding rockets	2 years for funded projects.
Earth satellites	Do.
Lunar probes	Do.
Space probes	Do.
Meteorological satellites	Do.
Communications satellites	Do.
Manned space flight	3 years for funded projects.
Solid fuel rockets	Continuing research and development studies.
High energy fuel rockets	Do.
1,000,000-pound rocket	4 years.
Nuclear rocket engine	Continuing long-term research and development.
Space engines	Do.
Auxiliary power units	Do.
Advanced vehicle systems	Do.
Booster recovery systems	Do.
Tracking and data acquisition	Yearly support of continuing program.

The Office of Space Flight Development has made commitment plans since January 31, 1959, for additional projects totaling $9.46 million. These are not reflected in the January 31, 1959, financial report.

The CHAIRMAN. May I say to the gentleman at this point that we have 4 pages of questions here that have been handed to me all relating to the Bureau of the Budget and to the budgetary figures. I want to put them into the record at this point. I do not think we can get answers to them at this time because it will just clog up the hearing at this point, but they should appear in the record and if there is no objection, I am going to ask that they be placed in the record at this point. They come from Mr. Fulton.

(The documents referred to are as follows:)

Mr. Chairman, yesterday, the representatives of the National Aeronautics and Space Administration appeared before this committee. There was not opportunity to pursue in detail some of their budget planning, detail which I believe is important to this committee if it is to discharge its responsibilities to the Congress. We were shown a chart which showed the overall level of budget requests, but it did not directly answer how much is going to be spent to speed our space program with the proper urgency.

I request that the chairman direct the Administrator of NASA to submit for inclusion in the record following yesterday's testimony sufficient detail of his program planning that this committee can have a clear picture of what NASA is up to. I want to know not only the amount which has been authorized and appropriated, and what is under request, but also what has been spent, what has been obligated, and what has been programed though not yet obligated. I want to know whether any funds have not yet been programed. I believe we should be told not only how much has been obligated, but in what years these obligated funds are to be spent. Obligation for long-term projects is necessary, but it can also be cover for stretching out programs to hold down expenditures.

Mr. Chairman, I think we should ask NASA to give us a listing of their major projects which they have programed, and what the current and expected future financial status of each of these projects is. I want to have them supply a list not only of the projects they are currently undertaking, but also a list of those projects which have been set aside for later consideration, or which have been abandoned for lack of funds. I want this list of projects underway and list of those set aside identified as to whether they are short run or long run in character. I want to see the justifications which have been developed for each of these programs.

It is my understanding, Mr. Chairman, that at a later date NASA will be coming back before this committee for authorization hearings. But meanwhile, I think the record should show this information I have requested so that the committee may have an adequate advance opportunity to familiarize itself with the plans and programs of NASA. I do not believe we are in any position to judge the adequacy of the NASA plans until they are presented in such form to make possible adequate analysis by the members of the committee.

Mr. Chairman, I request we specifically receive breakdowns of the research and development expenditures and plans.

FISCAL YEAR 1960

How much for research and development.
How much of this for astronautics?
Compare with fiscal year 1959.
How much for 1959 and 1960 is—
(*a*) programed?
(*b*) contracted for?
Breakdown for development of—
(*a*) propulsion.
(*b*) guidance.
(*c*) tracking stations, and so forth.
(*d*) man in space.
(*e*) medical—psychological.

The CHAIRMAN. I would like to ask you a question that I let go by in the interest of saving time.

First I would like to ask you this, Doctor—by the way, a colleague of mine mentioned this, but I had a question on it.

What about this McDonnell Aircraft contract? I have read a lot about it. Don't you think you ought to tell us something about it? Why is this company the recipient of that contract? What makes it qualified to handle it?

You covered it. You mentioned it this morning. But you didn't answer it in detail like we would like to have you do.

Dr. GLENNAN. I think if you want a full detail on it, we would be very happy to provide this for the record.

There were some 35 companies, I believe, that were invited to bid on the specifications. I think, as I recall, there were 11 that finally sent in proposals. These proposals were then divided as between the business end of it and the technical end of it, and we set up teams in each of these areas to evaluate the proposals of each of the 11 companies.

Those two teams, when they came up with their evaluation and rank-ordered the bidders, made their report to a third team which, again, put together the results of the first two teams. They then brought their findings to Dr. Dryden and myself and gave us their best evaluation of the proposals. And Dr. Dryden and myself, after about 2½ hours of question and answers on the work of these men, which had taken perhaps 15 man-weeks of effort, made this decision.

The CHAIRMAN. Now, was McDonnell rated the top one on your list?

Dr. GLENNAN. Yes, sir.

The CHAIRMAN. Wasn't it rated otherwise with the Air Force?

Dr. GLENNAN. Not that I know of.

The CHAIRMAN. Wasn't it rated some eighth or ninth in the Air Force?

Dr. GLENNAN. No. I am not sure why they would have rated them in any event. This was our competition.

The CHAIRMAN. You have thoroughly investigated the financial background and management of the company?

Dr. GLENNAN. This was one of the criteria looked into by our business team.

The CHAIRMAN. And McDonnell was the lowest acceptable bidder?

Dr. GLENNAN. No, they were not the lowest bidder.

The CHAIRMAN. Who was the lowest bidder?

Dr. GLENNAN. I don't know.

Mr. MCDONOUGH. Is this negotiated or a contract by competition?

Dr. GLENNAN. This is a negotiated.

The CHAIRMAN. Negotiated contract.

Mr. MCDONOUGH. Mr. Chairman, I am sorry. Do you yield to me?

The CHAIRMAN. Yes.

Mr. MCDONOUGH. This is the vehicle here, a plastic model of it. I think for the information of the committee you might bring it over in front of you and give us a little description of the purpose of its design and its function. This contains no power?

Dr. DRYDEN. No power. This is a substitute for the nose cose of a ballistic missile. It goes on the front end.

This frame on the top is a part of the rescue system in case of accident. If, for example, the engine would catch on fire on the launching pad, the pilot can fire this rocket, which would take the whole capsule up into the air to a sufficient altitude so that he could descend safely. When the vehicle goes in orbit, this part of the device is discarded. So that the vehicle is a pressure chamber containing a man.

The man is—I am sure we will have to pass this around for you to see it—the man is supported on a couch which is molded to fit to his form. Men supported in this manner have been exposed to accel-

erations as high as more than 20 G's in a centrifuge in Johnsville and have withstood this safely.

In the actual operation accelerations would not reach that value. The closest to it would be in an escape maneuver in low altitude in the dense atmosphere, where it might touch 18 or 19 G's for a few seconds.

The man is then protected against the launching acceleration. He takes it in the most favorable position; transfers through his body.

When the capsule goes into orbit, attitude controls are used to change the position in a manner suitable for reentry, so that this blunt end is first. The blunt end contains the heat shield, and here are the retrorockets which he uses to start his maneuver to come back to earth. The firing of the retrorockets, say, over Hawaii, will bring him down in the Atlantic missile range, something of this sort. It will reduce the speed enough to cause the capsule to spiral in toward the earth.

Mr. McDonough. You say he fires the rocket for retrograde over Hawaii?

Dr. Dryden. He would come in very closely, land somewhere in the Atlantic missile range for recovery.

Mr. McDonough. Clear across the United States?

Dr. Dryden. The reentry must be a very gradual one to keep within the bounds of acceleration and heat.

Mr. McDonough. What speed is he traveling when he fires that?

Dr. Dryden. He starts at around 18,000 miles an hour, something of this order of magnitude.

The Chairman. If he discharges the retrorocket in California, he will land in Florida?

Dr. Dryden. In that order.

The Chairman. Something similar to that?

Dr. Dryden. Something of this order.

Mr. McDonough. Does he stay in the reclining position at all times or can he move around?

Dr. Dryden. He will practically stay in that position. He can move his hands. He can exercise some control. There will be both primary and secondary controls on firing retrorockets, escape maneuver and all of this.

The medical people are engaged in deciding which shall be the primary control, and which will be the secondary control. Probably that will not be decided until the experience with flights to shorter ranges. The beginning of this project will fire full-sized capsules over perhaps a hundred miles at the start and then to successively greater ranges, first with instrumented capsules, some would contain animals, and ultimately, as a part of the pilot-training process, a man might take the shorter-range flight before going into an orbital flight.

The top part of this contains two parachutes—three parachutes, a small one to slow him down in the high upper atmosphere, a main parachute for the later part of the descent to the surface, and a spare to use if there is any failure of the first one.

The safety of the man has been considered in all aspects of this design. He of course is provided with communication devices. He

will be instrumented for physiological measurements of various sorts. He will be able to do some simple functions so that we get some idea of the capabilities of man in space.

Mr. McDONOUGH. This is Project Mercury, and this is the object that the McDonnell Aircraft is building for you?

Dr. DRYDEN. They are building some dozen or more of these capsules which will be used first in these qualifying experiments and finally for orbital flight.

Mr. McDONOUGH. How much thrust do you need to put that into orbit?

Dr. DRYDEN. An Atlas missile will do it.

Mr. McDONOUGH. We have enough thrust now?

Dr. DRYDEN. Yes.

Mr. McDONOUGH. And you say that—you have about a dozen under order?

Dr. DRYDEN. It calls for roughly a dozen, with some spare parts of various kinds, some extra heat shields. We hope to recover these, you see, and use them over and over. If we can't recover an instrumented capsule, then obviously we can't recover a man. So we plan to use them over and over.

Mr. McDONOUGH. What is the cost of this obligation?

Dr. DRYDEN. The contract is about $18 million, as I recall it.

The CHAIRMAN. What is that made of?

Mr. McDONOUGH. Inconel?

Dr. DRYDEN. Does anyone know the materials here?

The heat shield we will use in our experiments, both a berylium heat sink-type shield and an ablation-type shield. The material is titanium, someone tells me.

The CHAIRMAN. Is that the cost? Is it in the design or the material, the $18 million?

Dr. DRYDEN. It is the whole thing. They are working out the detailed design. We have given them general specifications. This is our rough idea. They don't have to use this. They come up with the detailed design and the manufacture of 12 complete with the communications equipment, the life-support equipment to furnish the oxygen, deal with the CO_2 and all the rest of it.

Mr. McDONOUGH. How large is the base of that compared to the base of that table?

Dr. DRYDEN. It is about 8 feet across.

Mr. McDONOUGH. Eight feet in diameter? And how high?

Dr. DRYDEN. It looks like overall about 10 or 12 feet.

The CHAIRMAN. Any more questions?

Mr. SISK. Mr. Chairman.

The CHAIRMAN. Mr. Sisk, all right.

Mr. SISK. I just simply, in view of the discussion on this particular instrument, I wanted to ask a question in view of some things I have read and heard and discussed.

Who evaluated the drag-brake system, Dr. Dryden, and determined your reasons for not using it in preference to this method?

Dr. DRYDEN. We are using a drag brake in the form of a small chute on this; this is being evaluated by actual drops from airplanes, simulating the final end of this trajectory. Those experiments are very well along.

Mr. SISK. Well now, there is what they term to be a drag-brake system, which I understand, I believe—there is something I read on this—which is somewhat different from this particular system.

Dr. DRYDEN. You may be referring to a proposal which is for a system not yet tried out or developed.

We are considering the matter of a research contract on this. But this project is not based on new technology or the completion of new research. We are using the presesent knowledge insofar as possible so as to drive this forward at the fastest possible rate.

Mr. SISK. Just to conclude, then, because I know our time is getting away:

You are having this other method evaluated, is that correct? If so, who is making that evaluation?

Dr. DRYDEN. Our staff has evaluated it in the sense that we would not make the success of this dependent upon the development of this device which has never been used, never been flown.

We have suggested to the proposer that we will entertain a research contract to develop that device for use in later application.

Mr. SISK. It is under evaluation, though?

Dr. DRYDEN. Yes.

The CHAIRMAN. I promised to recognize Mr. Anfuso.

Mr. ANFUSO. I withdraw.

Mr. OSMERS. How long do you propose the man to remain in this?

Dr. DRYDEN. Anywhere from 10 to a dozen orbits, probably about an hour and a half, probably only a few at first, because the launching will be from Canaveral, and you would like to make the recovery there where you have the ship facilities, tracking facilities.

Mr. OSMERS. He will be gone an hour and a half, then?

Dr. DRYDEN. He must be gone at least an hour and a half to go around once. You can go in multiples of this until the path of the satellite is changed so that it doesn't come over Canaveral. Then you have to wait 24 hours.

Mr. OSMERS. What do you contemplate on this first trip?

Dr. DRYDEN. Probably an hour and a half.

Mr. OSMERS. For one trip?

Dr. DRYDEN. Yes.

Mr. MCDONOUGH. This is a controlled entry?

Dr. DRYDEN. It is a controlled entry.

Mr. MCDONOUGH. He could stay up there longer?

Dr. DRYDEN. He could stay there longer.

The CHAIRMAN. Any further questions?

If not, Doctor, we thank you very much.

All three of you gentlemen here, we had you down here rated for 15 minutes on the program, but I think you can see by the interest shown from the members of the committee that we couldn't confine it to 15 minutes.

We certainly thank all of you.

Let's see, who is the next witness on the agenda?

Mr. DUCANDER. Mr. Chairman, Dr. Glennan?

Dr. GLENNAN. I just wanted to express my appreciation, Mr. Chairman, for the fact that so many of your committee have stayed through this session and have given us a chance to express ourselves.

We will be glad to come back at any time, and Dr. Stewart will carry on the balance of the program.

The CHAIRMAN. I think we had just about 100 percent attendance, and they have stayed all the way through, and all of that evinces their interest in your program there.

The best of luck to you, sir.

All right, Doctor, do you have a prepared statement?

Dr. STEWART. I do not, sir.

The CHAIRMAN. We will be happy, then, for you to proceed with whatever statement you wish to make.

Dr. STEWART. Thank you.

We have prepared a series of discussions here to provide you and your committee with a general view of the plans and activities that we are involved with.

I think in each case, as one of the men comes up to present his portion, I will ask him to introduce himself and to give a wee bit of personal history for your own background. We expect we will be seeing you in the future.

The CHAIRMAN. Sir, before you begin that, let me ask you: Would you give us a preview on what you have in mind? My thought there is this: If it is going to be impossible to see these last witnesses this afternoon, we should release them. If there is a possibility we can get to them, of course we want to go ahead with our program.

Dr. STEWART. What we have in mind is the following:

First, we would like to have Mr. Siepert, who heads up the Office of Business Administration in NASA headquarters, to spend a few minutes with you to show the picture regarding overall facilities, such as manpower, budget.

Then we would like to have Dr. Homer Newell, who is one of the oldtimers in the high-altitude research business, say a few words, telling you what is going on, how this started, and the kind of thing we are doing there.

Then we would like to go to Mr. Wyatt and Mr. Cortright, who are in the Office of Space Flight Development, who will describe the portions of the program in this, which is the newer area in NASA.

Finally we have Mr. Addison Rothrock who will speak of the research activities of the organization.

The CHAIRMAN. Fine.

Well now, that gives the committee an idea of what we have in front of us. We certainly want to hear everybody we can.

If you will call your first man, make your statement, sir, and then call your first witness, I think the witness will bear with you and we can speed this up some in order to hear most of the program that we have on the agenda.

Dr. STEWART. Very good.

Mr. Siepert, will you introduce yourself, please?

STATEMENT OF ALBERT F. SIEPERT, DIRECTOR OF BUSINESS ADMINISTRATION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. SIEPERT. Since I will be talking from charts, would you prefer I use the mike this way rather than try to come over?

The CHAIRMAN. Fine.

Mr. SIEPERT. My name is Albert F. Siepert, Director of Business Administration. I am one of the new staff-on-board, coming October 13. I am trained in public administration, I have had about 20 years of career civil service in five different agencies. Just prior to this job I served as executive officer of an organization I think some of you are familiar with, the National Institute of Health, which is the Government's largest program in medical research.

My particular job—do all of you have this organization chart in front of you? My particular job is in this area over on the left, the responsibility for seeing that the management requirements behind the technical research program are met. Specifically that means to see to it that men, money, the materials that the scientists need to do their job, is on hand as they need it.

Now, I would like to give you very quickly here what are the kinds of resources that are available to our organization to do this new job that is inherent in the new Space Act.

As Dr. Glennan pointed out, we are building on a foundation of the National Advisory Committee for Aeronautics, which has been the world leader in aeronautical research for many, many years. This is a large organization. It had some 8,000 people who came with us. They are scattered geographically in various places throughout the United States. Let me cover them briefly.

Here is a picture of Langley Research Center, Langley, Va., just north of Norfolk; about 3,300 people, the oldest and the biggest center. It specializes in aerodynamics research, structures, in aircraft operating problems and in pilotless aircraft. It happens that this is the center where temporarily we are housing the man-in-space project, in order that it can get the very best facilities that we have currently available.

Second, at Cleveland is the laboratory called the Lewis Research Center; 2,600 people. This is an organization that primarily specializes in engines, other propulsion systems, and materials research.

Third, out at Ames Research Center, at Moffett Field, just south of Palo Alto, Calif., we have the Ames Research Center in which we have concentrated aerodnyamic research. Particularly they have some very large wind tunnels, as you see here, for a much larger model of work.

Now, moving on down to here, these hangars, the high-speed flight station at Edwards, Calif. This is the terminus of the X–15 flights, this is where we carry out actual research with high-speed aircraft. Work with the X–1, the first plane to fly faster than the speed of sound, built under similar technical direction such as the X–15, by the NACA. This is where the X–15 will land.

Now, those are the areas we had before the program started, plus one other, called the Wallops Island Station, a pilotless aircraft station on the Virginia coast here, where we have been conducting experiments with small rockets, multiple stage rockets in exploring pilotless aircraft; only about 100 people in that organization.

Now, coming to the new space program, what we find is that we are building at Beltsville, Md., just outside Washington, on land given us by the Agricultural Experiment Station, a Beltsville Space Center. Here we will concentrate work in space sciences, technical

people who will concentrate on the development of our part of the program on payloads, a central data and collection center, so that we can make scientific use of the data we collect from these various probes.

Finally, from Beltsville we will concentrate our monitoring and our leadership of the research and development contracts that we place with American industry for the production of space hardware.

In addition we have taken over—here is a picture of the Jet Propulsion Laboratory operated by California Institute of Technology. This is located at Pasadena, about 2,300 people. They are retained by us on contract. This is a very well-known, outstanding research organization. Some of you doubtless have heard of its work on JATO, the jet-assisted take-off work during the war and subsequently on the Corporal missiles and the initial——

Mr. MILLER. About how big is the plant at Ames?

Mr. SIEPERT. Excuse me, sir. About 1,800. The other spots on here I will quickly point to. When we have a big booster to shoot, an Atlas or a Thor-Able or a Jupiter, it has been shot from Cape Canaveral where we have a field station there. As the Pacific test range opens up out here, we will put some facilities there and people when we wish to shoot on the Polar orbits.

Mr. MILLER. Is that the proposed one at Point Arguello?

Mr. SIEPERT. Yes.

Mr. MCDONOUGH. Near Vandenberg AFB?

Mr. MILLER. No. It will be at Point Arguello.

Dr. STEWART. It is directly adjacent to Vandenberg Reservation.

Mr. MILLER. Yes. But you see they can shoot north and south.

Mr. SIEPERT. The advantage is you can shoot south.

The CHAIRMAN. Are these facilities under NASA?

Mr. SIEPERT. The facility here is not, nor is the facility at Cape Canaveral.

The CHAIRMAN. Other than that, all of the facilities are under NASA?

Mr. SIEPERT. All of the ones that I have described.

The CHAIRMAN. What arrangement do you have at the cape and the other one out there on the Pacific Coast, at Vandenberg?

Mr. SIEPERT. Yes. We asked for the use of facilities when we have a scheduled firing. This is programed by the military services.

The CHAIRMAN. It is temporary use of the facilities during your operation?

Mr. SIEPERT. Yes, sir.

The CHAIRMAN. And they, in effect, loan you their housekeeping force at that time so that you can use the facilities for that?

Mr. SIEPERT. That is right, and we retain technical direction and management of the particular project.

Mr. MILLER. On the one at Point Arguello, when that is built, that will be your facility, will it not?

Mr. SIEPERT. You mean in terms of actual ownership. We do have in our budget construction funds to build a launching pad for us, yes.

Mr. MILLER. That will be under you?

Mr. SIEPERT. Yes.

Mr. MILLER. It may be on land—I do not know who is going to own the land, but it will be your facility just as at the present at Ames you are on Moffett Field, and at Langley you are on a Navy installation and at Wright-Patterson you are a tenant of the Air Force. Is that not right?

Mr. SIEPERT. This kind of tenancy, I can assure you has been most productive and quite satisfactory to us.

Mr. MILLER. Quite satisfactory.

Mr. SIEPERT. Yes.

Mr. MCDONOUGH. Your individual launching site, however, is Wallops Island.

Mr. SIEPERT. Yes.

Mr. MCDONOUGH. That is not used for military launching at all?

Mr. SIEPERT. No, but we believe in reciprocity.

Mr. MCDONOUGH. Yes.

Mr. SIEPERT. If they wish to use it, we would be happy to work out arrangements, yes.

Mr. MCDONOUGH. What about the new acquisition down at Chincoteague?

Mr. SIEPERT. The Chincoteague Naval Air Station is about 7 miles to the north of Wallops Island. It has been essential to our operations in terms of the air strips to permit us to get personnel and material, rockets and the like, in there, in a way that would be very difficult to do overland. We are discussing now with the Navy, because they are closing it, arrangements which we hope we would be in a position to make effective use of a part of those permanent facilities.

The CHAIRMAN. What about the missile range, the Atlantic missile range? What arrangements do you have with these other countries to use the facilities?

Mr. SIEPERT. We operate on the same agreements as does the Air Force in working with other——

The CHAIRMAN. You use the Air Force agreement with foreign countries.

Mr. SIEPERT. Yes.

The CHAIRMAN. You use their basic agreement when you use their range?

Mr. SIEPERT. Yes.

The CHAIRMAN. You get cooperation from all the armed services, do you?

Mr. SIEPERT. We are getting excellent cooperation.

Mr. CHENOWETH. Where is this Moffett Field?

Mr. SIEPERT. Four miles south of Palo Alto.

Mr. CHENOWETH. This chart indicates C.O.L. I thought that was Colorado, at first.

Mr. SIEPERT. I think that is an example of our too fast reproduction facilities.

Mr. MILLER. I would like to say something off the record.

Mr. CHENOWETH. Is there any particular reason why California should have all of these installations and we do not get anything in Colorado?

Mr. SIEPERT. I can only answer——

Mr. CHENOWETH. Is there some particular atmospheric condition out there that leads you to California?

Mr. SIEPERT. I can only comment on that that I am a newcomer to this space age, myself, and I cannot assume any responsibility for where the centers have been located.

Practically speaking I should say this, that some of the development on the west coast is directly attributable to the fact that the aircraft industry has concentrated on the west coast and much of the NACA program has been based on close cooperation with industry.

Mr. CHENOWETH. But do you not think that ought to be moved into the interior a little bit?

Mr. SIEPERT. I have no——

The CHAIRMAN. While we are talking about that, the most secure place in the country is down in Louisiana. Let us proceed.

Mr. SIEPERT. Now——

Mr. FULTON. We can give the gentleman from Colorado a stationary satellite 1,500 miles above it.

Mr. SIEPERT. These facilities that I have described and shown here in these pictures are very complex, very expensive, subject to a high rate of obsolescence, because the state of the art in the field of aeronautics and space travel is moving at an astounding rate. Take for example this little part of the Ames photo as broken up and shown here. This is a unitary wind tunnel, one of five facilities that were built starting in 1949. Unitary really means a national program of wind tunnels for joint use by Government and industry. This one at Ames has three sets of tunnels, one here and one here and one here, to cover model testing in the transonic and supersonic ranges, starting at about 70 percent of the speed of sound, up to several times the speed of sound, mach 3.5. Three of these for the NACA cost $75 million. Let us go quickly to a budget figure now.

Now, in order to get going on this program we had to organize a headquarters organization that was slightly different from that which had operated under NACA. The administrator has this immediate staff which you see on the chart. The NACA had the organization of Aeronautical and Space Research. This coordinated the work of the field centers I have described, and a small business organization over here. We have added a third one, the Office of Space Flight Development under Dr. Silverstein. This is the group in headquarters that is specifically responsible for the charting of our new course in space development.

Now, a closing word on the budget. This obviously is not intended to be a budget justification session, since we operate under authorization procedure. I think we will be back before you to discuss our budget in more detail. There are certain characteristics that you should know. The old NACA organization which we took over had a 1959 appropriation base of just over $100 million. This is for research and development within its own research laboratories. In addition there was $154 million of defense money representing space projects in various stages of work or planning which were turned over by Executive order to us. And the Congress appropriated $80 million to get the new program started, in addition to these two items. This gives us for 1959 a total of $335 million. You will notice it is made up of three kinds of things and I would like to explain these parts because

you will encounter them when you examine our budget. The blue area, which we call R. & D., is research and development contracting. I want to emphasize that. This is the amount that will be used to buy research services and actual hardware from nongovernmental, from non-NASA facilities.

This area, salaries and expenses, represents research, again, to pay for the scientists, the technical people and the supporting staff, to carry on aeronautical and space research in our own NASA laboratories. Bear in mind that at least half of that present research effort is related to space activities. The other half is primarily aeronautical activities. The green area, C. & E., represents construction and equipment. By that we mean the building of additional facilities for research work of one sort or another.

The 1959 supplemental estimate which has been transmitted by the President to the Congress ask for an additional $48 million, and the 1960 estimate is $485 million, of which one-third of a billion is research and development contracting, $94 million for salaries and expenses of the shop, and construction and equipment, $57.8 million. Basically this is the organization, the resources that we have. As I see it, and I think all my colleagues see it, we have a rough job to do. Our job is to organize this thing so it can roll, keep under constant study the changing requirements in this program, which are changing very fast, make decisions to mobilize our resources and then come in wisely and quickly.

Thank you.

The CHAIRMAN. Thank you very much, sir. Now if there are no urgent questions——

Mr. MCDONOUGH. Just one point, Mr. Chairman. Does this comprehend all of the functions of NACA as well as NASA?

Mr. SIEPERT. Yes, sir, this is the total budgeted program for the old activities carried right on in terms of our keeping in the forefront of aeronautical research as well as space flight development, yes, sir.

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller?

Mr. MILLER. Then as I take it, your 1960 budget, over two-thirds of it will be spent with nongovernmental agencies, with private research agencies and with, I assume, people in the air industry in research and development, is that correct?

Mr. SIEPERT. Not quite. Let me answer the question: Yes, with this exception, that if we are engaging with ABMA which has come up for discussion here, to buy Jupiters——

Mr. MILLER. That would come out——

Mr. SIEPERT. This comes out of this, that is right. So that included in here are interagency governmental transfers. But we are distinguishing here that which is spent within our own house for our own research staff.

Mr. MILLER. You mean less than one-third of it will be in your own house?

Mr. SIEPERT. Yes, sir.

Mr. MILLER. Thirty-two percent?

Mr. SIEPERT. Yes, sir.

Mr. FULTON. Mr. Chairman.

The CHAIRMAN. Yes, sir.

Mr. FULTON. When I had spoken previously I had spoken of $480 million. Actually it is $384 million for the current year. I transposed the 4 and the 3.

Mr. SIEPERT. Yes, sir.

Mr. FULTON. Now, how much of that for the current year is at present, first, unprogramed, and secondly, not yet committed, unobligated?

Mr. SIEPERT. I think the answer—you may wish to explore this in a little more detail.

Mr. FULTON. Will you submit it for the record later?

Mr. SIEPERT. Yes, sir. The answer is I would say it is programed. The answer whether it is obligated or not, you are dealing with about $40 million as yet unobligated.

The CHAIRMAN. Thank you very much. We have next Dr. Newell.

I am happy to state that Dr. Newell here is one of the consultants of this committee, too. We are happy to have him back in a different capacity at this time.

STATEMENT OF DR. HOMER L. NEWELL, JR., ASSISTANT DIRECTOR FOR SPACE SCIENCES, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. NEWELL. Thank you, Mr. Chairman. I am Homer Newell, Assistant Director for Space Sciences, at this point in the organization chart in the space flight development area.

For the past 12 years, I have been associated with rocket exploration of the upper atmosphere and had the great pleasure, as the chairman has mentioned, of working with this committee last year.

In my subject, I would like to review for you very briefly the background of space sciences. When research on the upper atmosphere began in this country with rockets 12 years ago, we had available to us sounding rockets that went to only 200 miles.

At that time the V–2 was the workhorse of the effort. From the V–2 we went on to Vikings, Aerobees, Rockoons, which are balloon-launched rockets and other vehicles, which for the most part did not get to above 200 miles altitude.

Nevertheless, with these vehicles a rather extensive program was carried out. Prior to the International Geophysical Year, which began on July 1, 1957, this country fired over 400 sounding rockets to investigate the upper atmosphere.

So you see that there was a rather extensive beginning program in space research when the IGY began. During IGY, we fired an additional 200 sounding rockets, and of course we launched our first space satellites and space probes.

Mr. MCDONNELL. You are speaking about the United States or the world?

Dr. NEWELL. I am speaking about the United States. This is the U.S. program.

Now, at the present time we find ourselves in this situation: We have greatly advanced vehicles and a rapidly advancing technology that the scientists can now use.

You recall that I mentioned earlier that the sounding rockets used previously went to about 200 miles altitude, maximum. Now our

space probes have gone out to over 70,000 miles and our satellites, of course, have been coursing above the upper atmosphere for some time.

We find ourselves with 12 years of experience in upper atmosphere research, and beginning of space research carried on with these sounding rockets and the satellites that we have launched. We find ourselves in the problem of a twofold task.

First, to collect the pieces of an extremely intricate puzzle.

And, secondly, fit those pieces together to get the picture.

Now, to give you some idea of the complexity of this puzzle, let me reveal to you one small corner of our area of interest, namely the earth's upper atmosphere. I think the chart will give you some impression of the complexity of this subject, and I should like in the next few minutes to try to go through it in order to remove some of that complexity on the basis of information gained during the last 12 years.

To begin with, here, pressure in the upper atmosphere, we know that it falls off with altitude. In fact, if you wanted an easy mnemonic, for every 10 miles you go up in altitude you divide the pressure by 10. This is easy to remember.

The same is true with the density of the atmosphere divided by 10 for every 10 miles you go up in atmosphere.

When you go up to 100 kilometers or 60 miles, you find that the atmosphere has become one one-millionth what it is on the surface of the earth.

When you get up to 500 kilometers, or above 300 miles, you find that the atmosphere has become one one-trillionth of what it was at the surface of the earth. There is therefore not much air with which to deal.

The CHAIRMAN. Do you mean in weight—do you mean one one-trillionth in weight or particles or what?

Dr. NEWELL. Pressure means weight, weight above that level.

Mr. MCDONOUGH. In other words, component parts of the atmosphere are lacking, is that correct?

Dr. NEWELL. That is correct.

Mr. MCDONOUGH. There is nothing there.

Dr. NEWELL. The number of particles per cubic centimeter is one one-trillionth of what it is at the surface of the earth.

Mr. MCDONOUGH. In other words, it is a vacuum?

Dr. NEWELL. It is not a vacuum, but it certainly—it wouldn't sustain life, it couldn't contain the body fluids in your body if you were exposed to it. It would not give you the lift that is necessary for ordinary aerodynamic vehicles.

Mr. MCDONOUGH. If a human being were exposed to that with no protection, he would fly apart?

Dr. NEWELL. That is right. Estimates have been given that he could last no longer than 5 seconds.

Mr. MILLER. As a matter of fact, you couldn't reduce a vacuum that low, or you couldn't evacuate a tube that low, could you, in vacuum, on the surface of the earth?

Dr. NEWELL. Not in our laboratories; no.

Mr. MILLER. In none of our laboratories could we reproduce the rarity of atmosphere that you would get at 300 miles, is that correct?

Dr. NEWELL. That is correct.

The CHAIRMAN. A human would blow up like a balloon at that altitude?

Dr. NEWELL. Yes.

Mr. MCDONOUGH. Is there any knowledge of what that emptiness contains?

Dr. NEWELL. Yes.

Mr. MCDONOUGH. That is the important thing. What does it contain?

Dr. NEWELL. I would like to emphasize that although this is emptiness, nevertheless it is extremely important, because as we will come to in a moment, the F region of the ionosphere lies up here, and it is this which makes it possible for us to send communications around the world.

Without the ionosphere to reflect back radio waves, we would be confined to line-of-sight communications. In other words, we have to set up repeater stations around the world in order to carry on our communications.

Another dramatic way of presenting the same information we have just been discussing is to consider the atmosphere as reduced to sea level conditions. Suppose we took our total atmosphere, which actually extends out for hundreds of miles and by some process or other could reduce it to the conditions of temperature, pressure, and density that we have at sea level, then we ask how thick would the atmosphere be? Under those conditions it would be 5 miles thick.

We have, then, 5 miles worth of sea level atmosphere.

What about the atmosphere in which the ionosphere lies, let's say above 135 miles? That portion of the atmosphere, reduced to the same conditions, is only one one-thousandth of an inch out of that 5 miles of atmosphere. Yet it is important to us from a communications point of view.

Another way to look at this is to ask what is the spacing between the molecules. At the ground, right where we are, the average distance between molecules is one one-hundred-thousandth of a centimeter, but when we get up to 60 miles the distance is 10 centimeters, and if we get up to 140 miles the distance is 1 kilometer, or three-fifths of a mile. And when we get up here to 300-some miles, the distance between particles is 20 kilometers.

Yet, in spite of this atmospheric rarity, it is extremely important in terms of the space research that we are entering upon.

Now, the primary driving force of our atmosphere is energy from the sun. This energy from the sun entering partly gets through the atmosphere, but in the ultraviolet and gamma ray regions, it is absorbed in the upper atmosphere, causes heating, gives rise to radiations that we call the airglow, night glow, causes ionization, and gives us the ionosphere, and this curve represents the intensity of ionization.

This is due to ultraviolet light and the X-rays being absorbed in the upper atmosphere. It causes a change in the molecules, so that what was oxygen molecules on the ground become oxygen atoms up here and become ionized.

A small amount of energy is brought in by meteors, some by starlight, some by cosmic rays, but the amount of energy brought in by those sources does not match nearly the amount brought in by the sun.

Now, in our studies of the upper atmosphere we have used the Rockoon, the Moonwatch rockets, the Nike-Cajun developed by the NACA, the Viking developed by the Navy, and of course the satellites launched during the IGY.

With the satellites and higher sounding rockets and deep space probes, we are now able to move from this, I say, small corner, fairly complicated, but nevertheless small corner of our subject of interest, to study the entire universe.

And here we have illustrated schematically our areas of interest. The earth's atmosphere we have just discussed. Out beyond the earth's atmosphere we can now observe the distant galaxies, the stars, the medium between the stars and between the galaxies, the medium in interplanetary space, the sun itself, Venus, Mars, and the other planets and the earth—I beg your pardon, the moon, in wavelengths that we could not see at the ground.

You will recall in the previous chart I mentioned a large segment of wavelengths, the frequencies coming from the sun, were absorbed in the atmosphere. That was another way of saying that we didn't get to see them on the ground.

Yet it is probably true that there is more information contained about the universe than contained in those wave lengths that we do not see, than in the wavelengths in the visual or radio region.

This, then, gives you a very brief overview of some of the complexity of the space research that this country wants to do in the years to come.

The question now arises as to how we propose to conduct the program.

Mr. McDonough. Before you do that: In your description of these various gaseous bodies, that is interstellar gas and the galactic radiations up there, does the spectroscope analysis of those gases indicate that there are elements that we do not know in any of those, or do they contain the same elements that we do know?

Dr. Newell. They contain the same elements that we do know. We have seen no new elements out there. In fact, the gases are largely hydrogen and helium, with small amounts of other molecules.

Mr. McDonough. Is that interstellar gas body an isolated body, apart from itself, and the universe, or is it in a band around any part of the universe?

Dr. Newell. The interstellar gas, in our own galaxy, is distributed throughout the galaxy. It clusters in dense clouds at times, called nebulas, and is distributed between the galaxies in a much more attenuated form.

To give you some idea of how much gas is in our own galaxy, the total mass of such gas is about equal to the total mass existing in the stars, individual stars.

Mr. Fulton. Would you yield?

Mr. McDonough. Yes.

Mr. Fulton. We really can't say that there are not some subatomic particles out there because we have no instrumentation to determine whether there are or not; isn't that right?

Dr. Newell. That is quite correct; that is why I said we have detected no different particles.

Mr. Fulton. But we have been able to get high energy radiation of a different kind, both primary and cosmic, and also we have gotten

the new plasma, as it developed, from our IGY experts, have we not?

Dr. NEWELL. The great radiation belt; yes.

Mr. FULTON. So that really as far as that is concerned, we are much ahead of Russia on that particular angle, aren't we?

Dr. NEWELL. I think in the upper atmosphere and space research, we are ahead of the Russians. This is one area in which we are giving them a good run for their money. In fact, in Moscow last August the general feeling seemed to be, not only among the U.S. scientists, but other nations as well, that the material presented by the U.S. researchers was ahead of that which was entered by the Russians, both in quantity and quality.

Mr. FULTON. Likewise, we are ahead of them in communications in this area of what you would call the satellite methods; isn't that right?

Dr. NEWELL. You mean the use of the satellites for research?

Mr. FULTON. Yes. We are the first one that has communicated with a satellite.

Dr. NEWELL. Yes. I would say we have made better use of limited weight that we have put in orbit than the Russians have.

Mr. FULTON. For example, we aren't the only ones ahead of Russia. At the University of Manchester on a Jodrell Bank radio telescope, Dr. Lovell has picked up radiations from 2,000 light years, which is the equivalent of 52 billion miles—52 trillion miles—which is 26 million miles to a light year; isn't that right?

Dr. NEWELL. Yes; and in fact he has picked up radiations from even farther that that.

Mr. FULTON. The chairman says I am in error by a trillion miles. [Laughter.]

Mr. MCDONOUGH. You don't show anything on this description of this band of cosmic rays that Dr. Van Allen——

Dr. NEWELL. This is down in the atmosphere, about 100 kilometers, or 60 miles out.

Mr. MCDONOUGH. Where is this cosmic ray band that Dr. Van Allen referred to?

Dr. NEWELL. Dr. Van Allen's band is out between 2,000 and 30,000 miles from the surface of the earth.

The CHAIRMAN. Any further questions?

Mr. FULTON. Can we just finish on that?

Dr. NEWELL. Yes.

Mr. FULTON. It is 2 billion light years, isn't it, that Dr. Lovell has gone?

Dr. NEWELL. Two billion light years.

Mr. FULTON. And each light year is 6 trillion miles?

Dr. NEWELL. Six trillion miles, that is right.

Mr. MCDONOUGH. That is a "fur piece."

Mr. FULTON. Two billion times six trillion in distance, we have gone further than Russia has gone in picking up radio emanations?

Dr. NEWELL. Yes.

Mr. MILLER. How do you distinguish between a billion and a trillion? I have a hard time distinguishing between 10,000 and 100,000.

The CHAIRMAN. Well, let's get along with the program, gentlemen. We want to thank you. If you have completed your statement, we want to thank you, sir.

Dr. NEWELL. I have one more remark, if I may, on how we propose to conduct our program. I think the committee would be interested in hearing this.

We have now the momentum of the International Geophysical Year in which the rocket and satellite teams that we have gathered together are the most powerful such research teams in this area ever assembled. It is NASA's plan to build up and develop these teams so that the space research program is carried forward on a broad base.

As an estimate, we would say between 10 and 20 percent in house-work and 80 percent of research done by agencies throughout the rest of the country.

The CHAIRMAN. Thank you very much, Doctor. Who is next?

Dr. STEWART. Mr. Chairman, Mr. D. Wyatt will follow on with some discussions of the space program, with the emphasis placed on the direction of the requirements for vehicles, propulsion for various kinds of advanced missions.

STATEMENT OF DEMARQUIS D. WYATT, ASSISTANT TO THE DIRECTOR OF SPACE FLIGHT DEVELOPMENT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. WYATT. Gentlemen, my name is De Marquis Wyatt. I am technical assistant to the Director for Space Flight Development. I have been with the NACA for 15 years, multilaterally as Associate Chief of the proposed Aerodynamics Division at the Lewis Research Laboratory Division, in charge of two of the largest wind supersonic tunnels in the world.

I propose to talk with you in a brief talk on some of the objectives of the space flight development, the new part of NASA.

Now, we take a total program that we think is essential and we can look at it several ways. For one, we can talk about the scientific objectives, one main category. Second, the applied technical objectives, that is the use of space for such purposes as communications, meteorological, and so forth.

And thirdly, the advanced technology backup which is an integral part of the program and which is required to further the first two parts of the program. In other words, we have to devote a lot of effort to the improvement of the technology so that we can get further along in both the scientific and applied areas. This will be one way of presenting the program.

Now, there is yet another as indicated on my first chart. This, as you look at it more by mission areas, I have outlined the mission areas of earth satellites, lunar exploration, planetary exploration, and solar probes. Now in the earth satellites we have the scientific objectives of the sort discussed by Dr. Newell. We have applied objectives in the field of communications, gentlemen, which will be touched upon by Mr. Cortright in succeeding talks.

As sort of a hybrid here we have the orbiting laboratories which Mr. Cortright will also discuss. Lunar exploration, there are a number of steps that are going to be essential. First are those involving the sending of probes to the vicinity of the moon and orbiting missions around the moon. I shall discuss in a moment some of the propulsion requirements to accomplish these missions.

We, of course, have attempted several probes; the Russians have made one successful probe in the vicinity of the moon. The next step is going to be making instrument landings on the moon, what we call soft landings. I will discuss these in just a moment.

Finally, we will get to the point where we will be able to make manned landings. From here on we don't know what the future holds.

Planetary exploring will follow the same general trend, except in this case I have not indicated the manned landings within a technical feasibility within the period that we can see ahead. Solar probes, this is a matter of taking an instrumented probe and dropping it into the sun, let us say.

Actually this is a job of very great magnitude. To give you an indication, we have to put a total velocity impulse on a rocket to go to the moon or say, a rocket to go into orbit of around 30,000 to 33,000 feet per second, in order to put an object into orbit around the earth.

In order to drop, if you will, a probe into the sun, we will have to put around 100,000 feet a second total velocity. You can guess that this would require a very high order of propulsion magnitude.

Now, the objectives in all of these—let's take the scientific objectives—can be summarized in this kind of chart. Dr. Newell has talked about findings with sounding rockets. We rather arbitrarily define sounding rockets as vertical shots that go no further than one radii from the earth, about 4,000 miles.

Actually most of our shots today have been in the 200- to 400-mile range. We are working on advanced designs of these rockets which will be fairly cheap rockets. In this manner we can explore the portions of the atmosphere near the surface of the earth.

Then we have the satellites, with which we are all familiar. This is shown on what we call an elliptical path, rather than a circular path around the earth. Then finally we have the space probes which go out farther than this distance at 4,000 miles. The space probes can be divided into near space, lunar, interplanetary and so forth.

Now, the satellites that we will be launching are not few and simple. That is, you do not accomplish a scientific program, a total program by launching one or two satellites. On this chart I have indicated some of the complexities that are necessary in our satellite flights.

The general purpose of making a number of paths is to provide variations in time and position for the measurement of the scientific quantities of the sort Dr. Newell just described.

These satellites we have been launching today have what we call inclined orbits. That is, they are launched at an angle to the equator and go around in this direction. It will be very desirable to launch polar orbits which will pass from the north to the south poles. To do this we will have to use the Pacific missile range, because there we can get the down-south firing over unpopulated areas. We can fire inclined orbits from the Atlantic missile range, at Cape Canaveral. It will also be desirable in the future to have firings which have equatorial orbits, run around in the direction of the equator. To do this, it is going to be necessary either to set up launching bases close to the equator or develop more powerful rockets that will allow us to dog-leg onto the equatorial path.

The other circumstance that we must provide for in our programing is that some of the orbits should be almost circular, this to get us a uniform altitude above the Earth for the collection of scientific data, whereas from time to time it will be desirable to go into what we call highly elliptical orbits, for example, for the examination of the great radiation belt discovered by Dr. Van Allen, because in this manner we get a vertical section into the atmosphere over the Earth.

The space probes give us a means of proceeding far away from the Earth. On this chart we indicate that the purposes of the space probe, scientifically speaking, are to give us cross sections into space, to the Moon, to the other planets or to the Sun and to give us observations in the vicinities of these bodies, because we expect to learn a great deal, oddly enough, about the Earth, itself, and the factors influencing the Earth from studying the atmosphere and the characteristics of the planets.

Now, these flights are much more audacious than any that have been attempted to date. The flights to the Moon require a very sizable effort, but the distances involved and the energies involved are much smaller than those involved, for example, to go from the Earth to Venus as indicated by this inward path or from the Earth to Mars as indicated by the outward path.

We can pass from the Earth to Venus by what we call a minimum energy trajectory, which is the least amount of thrust that we can put into our rocket, which requires long times, or as indicated here we can go either inward or outward on what we call excess energy trajectories, providing we have the thrust capabilities that can greatly reduce the transit time to the body.

Now, not only must we have highly developed propulsion systems to accomplish these planetary probes, we must also develop power supplies so that we can transmit back the data from these very large distances and over a considerable length of time, perhaps in periods measured up into months and even years in some of these scientific explorations.

We must also develop the ground tracking equipment to receive this communication. The dishes that Dr. Newell or Dr. Stewart spoke of, the Goldstone dish, for example, to receive the signal from the probe. These must be developed technologically in order to permit the probe to operate with a minimum of transmission.

Mr. Cortright will discuss some of these aspects in his discussion.

Taking particularly the lunar exploration phases, proceeding from the probes of the sort that we have attempted and the Russians have attempted which simply pass by the Moon in one shot and then assume a position of trajectory about the Sun, the next step would be the unmanned orbit or a body that we send up and actually orbit around the Moon without attempting to bring it back.

Later on the greatly increased energy requirement, we may find it desirable to bring even the other vehicles back to the Earth. The next stage will be one of landing on the Moon, however. We have two categories of landing. The hard landing, which is simply that, where we come in at a very high velocity and hope to design the unit so that we can still obtain data and transmit it after impact. This is not impossible. It has been used in certain of the areonautical research in this country.

It depends upon a good many factors, however, including a choice of suitable terrain, which we are not likely to have in our initial flights to the Moon.

Hence we look to the soft landing, as the more desirable feature. By soft here we mean to let the package down slow enough so that we are fairly certain that it will continue to receive and transmit data.

And the difficulty arising here is that we have to destroy the energy that the vehicle has as it approaches the Moon or as it orbits the Moon in order to let it down at essentially zero speed on the surface of the Moon. This requires a large propulsive effort and this, in turn, requires to carry out to the Moon a rather large rocket, which has to be extended. This cuts down the payload we can put on the Moon.

Later on I will show you the magnitude of the payload that we expect to put on the Moon. The next step will be a manned orbiter around the Moon. I am taking these in the order of technological difficulty. Here we expect to put out a man or men and have them circumnavigate the Moon at a fairly close distance and then, of course, return to Earth.

Finally we come to the most difficult mission, that of landing a man on the Moon and then bringing him back. I shall point out in just a moment the difficulties that are encountered there, but to do all these jobs we have to have thrust. My portion, the main portion of my talk, I want to talk about these thrust problems.

Mr. Cortright is going to talk about some of the other problems that we have to solve.

Here are shown schematically the existing vehicles available to us in our space research. You can get an idea of the size from the figure of the man. We have the Vanguard, Jupiter-C, basically a Redstone missile with upper stage added. Juno-II which is the same as the Jupiter-C using a Jupiter first stage, and the Thor-Able, made by combining the Thor rocket with the upper stages from the Vanguard. These are the vehicles that we have available to us at the present time. The payload capabilities of all these vehicles at the present time are rather limited in terms of pounds, as you know. In the very near future we hope to have several vehicles available based upon the Atlas which will give us greatly increased potenialities. Then one step further down the line—these are the Atlas Hustler engines—the next step down the line is to go to a stage which again uses the Atlas modified for the first stage and then uses new upper stage rockets.

The Atlas at present is what they call a stage and a half rocket. To get large increases in payload, it is necessary to add more staging, more rockets on top of that. These I will state, two of them, we consider essential to prosecute a space flight program. One that would actually come first in timing would use a modified first stage Vanguard engine, as a second stage using conventional fuel, and use a third stage of storable propellants under development.

The other system which would have an increase in payload capability would use a high energy second stage, otherwise it would be similar to this rocket here which we refer to as the Vega rocket.

Now these still do not have the capability to perform the missions I have been talking about. The next stage in rocket development

underway now are the really advanced boosters. Now you will have noted here the figure of the man may have gotten so small that some of you at a distance cannot see it. Over here, what we refer to as the million-pound cluster actually will be somewhat over a million pounds in its final development. It is a cluster of rockets and the first stage, second, third, and fourth stages. The first stage is now being developed by ABMA. Over here we show by comparison the rocket which we call Nova that will be based upon a cluster of the 1½-million-pound single-barrel engines, discussed with you earlier today.

Here again we would have a cluster of these engines for the first stage, one of the engines for the second stage and succeeding stages up here. It is only when we get to the 6-million-pound cluster that we can accomplish some of the missions I have discussed.

Some of them cannot even be accomplished with the 6-million-pound thrust. For example, here is a payload potential for putting a satellite 300 miles above the earth. With the existing capability we can put about 300 pounds into orbit. This is sufficient for a good amount of instruments. This is not enough capacity to engage in some of the communications, meteorological work we wish to engage in, nor for advanced scientific experiments. It is not possible to put a man, of course, with a 100-pound payload into a 300-mile orbit. I might say in passing that you can put much larger loads into lower orbits. With the Atlas Hustler system which should be available in a few months, our capacity in this 300-mile orbit will go up to about 2,000 pounds. When we get this Atlas with the upper stages that I have referred to, we will be up to over 7,000 pounds capacity. Our million-pound cluster will enable us to put 19,000 pounds into orbit and when we get this 6-million-pound cluster we will have the potential for 150,000 pounds.

Mr. Cortwright, in his discussions, will discuss a mission in which we feel we can definitely use 150,000 pounds in a 300-mile orbit.

Now, the next mission that we can look at is that of a 22,000-mile orbit.

Mr. McDonough. Before you get away from that, these varying instances you are talking about there are dependent upon the design or the propellant?

Mr. Wyatt. Both. Some of them involve higher energies, propellants, some of them are bigger engines than we now have available.

Mr. McDonough. What I am getting at is: The propellants we know now and the design we know now, can be, with some research and development in the next year changed considerably? We haven't the ultimate in propulsion yet, have we, in either solid or liquid?

Mr. Wyatt. No, sir, not in a practical form. However, some of these engines carry in their upper stages some of the highest energy fuels that we know of.

Mr. McDonough. In which category are we advanced the furthest, the design or the propellant? At the present time, can you give us an idea?

Mr. Wyatt. I would say the propellant is a little ahead. In other words, we will be able to get some of the upper stages using high-energy propellants sooner than we can get—much sooner than we can get some of these very big engines using conventional fuels.

The CHAIRMAN. May I say to the gentleman that the committee is planning a special investigation of propellants at a later date, however, most of it will be executive, because of the nature of the inquiry.

Mr. WYATT. Yes.

The CHAIRMAN. Proceed, sir.

Mr. WYATT. Well, this 22,000-mile orbit is of interest, because if we put a satellite 22,000 miles or very approximately that, above the surface of the earth on an equatorial orbit, it would appear to be stationary relative to a point on earth, because it would spin around once in 24 hours. Here we have what we call a stationary satellite. This has certain advantages in space, because we can have a family of three to six of these continually observing fixed spots on the earth for meterorological purposes, or repeating messages, as the case may be.

However, with the rockets that we now have or those that we will have available, we have no capacity for putting a payload into a 22,000-mile orbit. We get that capacity when we get to the upper stages, with the Atlas missile, and we build that up until again out here the 6-million-pound rocket, we get a very large capacity for this. Actually, in here we have the capacity for performing a good many of the meteorological missions.

Now, the next mission I want to discuss is that of putting a payload softly on the moon, or a lunar landing coming in, orbiting, and then landing with a soft landing, essentially zero velocity.

Here again we have no capacity for doing that at the present time.

Well, with the Atlas Hustler we will have a capacity to put a small instrumented payload on the surface of the moon. This capacity will build up rather slowly through our million-pound cluster. Not until we get to our 6-million-pound engine will we be able to put about 20,000 pounds on the moon.

Mr. MCDONOUGH. What is your time schedule on that?

Mr. WYATT. This one will be out—

Mr. FULTON. Don't say more than 7 years.

Mr. WYATT. I was going to say 6 to 8 years. This is the first one which, of course, you can begin to talk about putting a man on the moon. This does not yet bring him back. Actually, we take the case of landing on the moon and returning to earth. This rocket will give us the capability of bringing back 1 ton to the surface of the earth. This is about the weight of Project Mercury, about the minimum weight that we consider for putting a man out to the moon, landing him, and bringing him back to the surface of the earth.

Mr. MCDONOUGH. You mean you need that weight to put him up there and give him propulsion to get back?

Mr. WYATT. Right. We would have to have a payload leaving the earth of over 4½ million pounds in order to bring 2,000 pounds back to the surface of the earth.

The CHAIRMAN. So that missile, the 6-million-pound cluster, will be the basic missile for that purpose?

Mr. WYATT. Right; yes, sir.

The CHAIRMAN. Nothing less than that would do?

Mr. WYATT. Nothing less. The million-pound engine will not do that.

The CHAIRMAN. Nothing larger than that is planned at this time?

Mr. WYATT. Not at this time. However, this picture will change

as we advance in this technology. We do not say that 6 million pounds is the biggest rocket, biggest booster, that we are going to need. It is very obvious here that we can only do a minimum job as far as lunar exploration is concerned with a man, using even the 6-million-pound rocket. So it is going to be necessary in the future to go to even larger booster sections.

Gentlemen, this gives the picture of the way the mission capabilities that we desire to perform are linked in with the propulsion systems available to us, and an indication of the kind of propulsion systems that we are supporting in the future program.

The CHAIRMAN. Thank you very much.

Mr. FULTON. May I compliment the witness, because he has just now subtracted 1 year over Dr. York's 7 years.

The CHAIRMAN. Therein he fell into serious trouble.

Mr. WYATT. Thank you.

The CHAIRMAN. Now, gentlemen, we have one more witness tonight. We have been here since 10 o'clock this morning. The reporter is rather fatigued.

Mr. HALL. May we ask a question before this witness leaves?

The CHAIRMAN. Just come back, sir. They want to ask you a question or two.

Mr. HALL. Where does Russia stand on that scale now, so far as we know?

Mr. WYATT. Well, we don't know. I don't know definitely. It was indicated to accomplish their lunar mission that they had anything from a quarter-million-pound thrust up, depending on what we call the sophistication of their design.

Mr. HALL. Do we have any way of telling when they fire one of these missiles other than for them to tell us or to release the news? Do we have any detection systems?

Mr. WYATT. Do you have an answer to this?

Dr. STEWART. This is really a military problem which I think would be best to explore with the military.

Mr. HALL. That is all.

Mr. QUIGLEY. May I ask a related question?

The CHAIRMAN. Yes.

Mr. QUIGLEY. On the chart that you showed as to the 22,000-mile orbit, are the Russians currently capable of doing something in that area?

Dr. STEWART. I think the only proper answer is "Yes."

The difficulty with the 22,000-mile mission is a little bit greater than that of a passage by the moon, but not very much greater. So I would say that the general equipment that they have already demonstrated a certain capacity for this kind of thing. It would not be very many hundreds of pounds, but it would be more than zero.

Mr. QUIGLEY. So that we run the risk of the first worldwide television network carrying Russian broadcasts rather than English?

Dr. STEWART. This is conceivable, sir.

Mr. FULTON. You do not mean that there is going to be a 22,000-mile orbit that is a stationary vehicle, because they do not have any power of making a circular orbit or an eliptical orbit whose two focuses are within the diameter of the earth?

Dr. STEWART. That is quite right, sir. The problem is not a simple one. It is a very complex guidance problem. They also require spe-

cial propulsion systems for use after you get out into the 22,000-mile station, so that the statement I made should have been more accurately stated, that they have the propulsion capability to launch a vehicle which might be used in that capacity.

Mr. FULTON. In an eliptical, but no capability in a circular orbit, which I believe the gentleman was discussing.

Dr. STEWART. I believe even a circular orbit they have a capacity for a little there, not as much as they put on the moon, because a good portion of that requirement had to be used up with the extra propulsion and guidance to establish a circular orbit.

The CHAIRMAN. Why is it a 22,000-mile orbit rather than 24,000?

Mr. WYATT. This is the way the mechanics of it work out: It is around 22,300, I believe. We just rounded it off.

The CHAIRMAN. 22,300. That will make a stationary——

Mr. WYATT. It makes it go 24 hours to make one turn around the earth, yes, sir.

Mr. Quigley, I would like to correct what may have been a misapprehension, when you said if the Russians are the first to put anything into the 22,000-mile orbit, they would be the first to have worldwide television.

There are other ways of getting the worldwide television service without having the stationary satellite.

Mr. FULTON. You could have a number of satellites, could you not?

Mr. WYATT. Yes.

The CHAIRMAN. Gentlemen, it is after 5 o'clock, and the reporter has been going all day long. I think in fairness to him—he must be pretty tired. The committee members having been here also since 10 o'clock—we can get Mr. Cortright, he would be available, wouldn't he, later on? And also we have two other witnesses this afternoon that we released earlier with the thought that we wouldn't be able to reach them.

If there is no objection on the part of the committee, I have this in mind:

Tomorrow morning we have the Army here to tell us what the story is from the Army viewpoint, give us the national defense angle. If we excuse these three witnesses now, we can call them later on in the course of this hearing, giving them ample notice. I think there would be a better reception, too, if we are a little less fatigued than we are this late in the day.

If there is no objection, my thought is: We would go on tomorrow with the Army and hear these three witnesses later on, hear their testimony and place it in the proper place in our record.

Is that all right, sir?

Dr. STEWART. Yes, sir, we are at your convenience.

The CHAIRMAN. We certainly thank you for a very painstaking presentation that you have made this afternoon and this morning. The committee appreciates everything that you have done. If there is no further business, and I assume there is none, we will adjourn until tomorrow morning at 10 o'clock.

(Whereupon, at 5:15 p.m., the committee recessed.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Tuesday, February 3, 1959.

The committee met at 10 a.m., in room 219, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order.

This morning we are going to hear from the Air Force and we have the privilege the first thing this morning, gentlemen of the committee, to hear from the distinguished Chief of Staff of the Air Force, an able witness, a fine gentleman, and a great military leader, who has followed the program that we have under study all the way through. I refer to Gen. Thomas D. White.

General White, I think we have a formal statement to hear from you and if you wish to proceed with this statement we will be glad to have it.

General WHITE. Very good, sir.

The CHAIRMAN. Proceed with your statement, General White.

STATEMENT OF GEN. THOMAS D. WHITE, CHIEF OF STAFF, U.S. AIR FORCE

General WHITE. Mr. Chairman, members of the committee, I welcome this opportunity to discuss with you the subjects under consideration by this committee today. They are subjects which are not only extremely vital to the Air Force as we advance deeper into aerospace but which are uppermost in all of our minds these days as a matter of utmost national emergency.

The President has stated that we and other nations have a great responsibility to promote the peaceful use of space and to utilize the new knowledge obtainable from space science and technology for the benefit of all mankind. This is the overwhelming desire of all of us. Moreover, it is with this basic premise in mind that the Air Force appears before you today and all witnesses in giving their replies and testimony have the intent to testify within this statement of policy. However, until effective measures to this end are assured, the capability of the free world to operate freely and purposefully in

space will depend upon a strong and capable deterrent aerospace force.

Aerospace is a term which may be unfamiliar to some of you. Since you will hear it several times during the course of our presentations, I would like to define it for the committee at this time. The Air Force has operated throughout its relatively short history in the sensible atmosphere around the earth. Recent developments have allowed us to extend our operations further away from the earth, approaching the environment popularly referred to as space. Since there is no dividing line, no natural barrier separating these two areas, there can be no operational boundary between them. Thus air and space comprise a single continuous operational field in which the Air Force must continue to function. This area is aerospace.

The major military threat which faces our Nation today lies in Soviet aerospace power, even though at the moment this power is expressed in terms of aircraft and ballistic missiles. The primary military deterrent which has contained this threat and which has precluded it from developing into catastrophic reality is U.S. aerospace power. This has been true for the past 10 years with our conventional and early jet fighters and bombers. I am convinced that it will continue to be true as we operate with improved jet aircraft, missiles, and eventually spacecraft and satellites. The decisive weapons of the future will be aerospace weapons. That nation or group of nations which maintains predominance in this area, not only in its military forces, but also in its laboratories, in its industries, and in its technology, will possess the means of survival.

In any new program—and the space efforts of this country are relatively young—it is often difficult to separate basic scientific research from military potential. Never in history has this delineation been more difficult and yet more critical than in this era of limitless scientific expansion. Proper definition of this problem is one of the most imposing responsibilities resting with those who must guide our national space effort to its proper goals. It is our thought in the Air Force that there is at this point in time little, if anything, in the area of basic space research, which may not have some degree of military application. We are interested in the machines to get us into space. We are interested in the problems facing man in space and we must obtain answers to many other related questions before a firm military capability can be established in space.

In the early stages of this program, our scientific and military interests will in many cases be synonymous and simultaneous. This being the case, extreme caution must be exercised in areas wherein basic research might be mistakenly separated from urgent military requirements to the detriment of those military requirements. In these critical days the practical use of space knowledge must be considered

primarily from the standpoint of their application toward the security of this Nation and of the free world—until such time as the use of space for peaceful purposes is assured.

The exploration and exploitation of space is an expensive program in money, resources, and effort. It is also a critical program from the standpoint of time when we consider the threat which faces us. Strong control and tight coordination are needed to acquire the space posture which we must have and at the time we must have it. Our national space program must be comprehensive in scope and must closely coordinate the full potential of our national resources if it is to meet effectively the challenge of world leadership in this field. The policies and programs of the Air Force reflect these national objectives.

At this stage of our growth in space technology, requirements and their implementing developments must move at an extremely rapid pace if we are to meet the urgent military and scientific threats which face us today and which we know will face us tomorrow. We must remain fully sensitive at all times to the impact that space technology's swift advance will have upon aerospace systems and operations and we must be able to move with speed, purpose, and directness to exploit these advances. There is no question in my mind that we have the ability to attain our goals in space nor that we will attain them provided that we keep clearly in sight and remain constantly aware of the dangerous detours through which duplication, indecision, and diffusion can lead us.

In closing, I would like to emphasize that our defense posture must be measured at all times against our entire aerospace capability and it must be computed against its capacity to accomplish the mission assigned to it. Total aerospace power includes manned and unmanned air-breathing vehicles, spacecraft, and satellites and ballistic missiles. Each weapons system supplies a definite and unique contribution to our overall defense capability and each is judged by its performance in relation to the whole. The value of one cannot be properly computed except in context and in conjunction with the contributions of the others.

We have prepared detailed presentations for you concerning the space program as it affects the Air Force mission. First, Lieutenant General Anderson, commander of the Air Research and Development Command, will discuss the organization of the Air Force as it particularly pertains to our space effort. He will be followed by Major General Schriever, commander of the Air Force Ballistic Missile Division, who will brief you on the intercontinental ballistic missile program.

Following their presentations, we will be happy to answer your questions on this portion of the overall briefing. I will then turn the briefing over to Brigadier General Boushey, the Director of Advanced Technology, in Headquarters U.S. Air Force, who will carry on with a detailed discussion of Air Force space projects and capabilities.

Our presentations today will be divided into two sections, the first being unclassified, followed by classified sections of the briefings. I would now like to present Lieutenant General Anderson.

The CHAIRMAN. The classified sections of the briefing will be at the end?

General WHITE. That is correct.

The CHAIRMAN. So everybody can remain for the open session. I want to ask you one question before you present General Anderson, if I may: In your mind, in your position as Chief of Staff of the Air Force, how vital do you feel that the successful prosecution of this program of aerospace is to the security and preservation of the United States of America? It is a general question which a great many of our people ask us.

General WHITE. Well, it is my personal and considered view that the move forward into space is perhaps even more important than in 1903 when the aircraft first came on the horizon. None of us dreamt what aviation was going to do to civilization, and I think the same on an expanded scale can be said about space, perhaps in proportion as the one exists to the other relative to the size of space.

The CHAIRMAN. Now you being a military man or an airman, with your feet on the ground, and realizing what is fundamental to the defense of the Nation, would you say that this program of conquering the aerospace is one that we appreciate the importance of, as a people, and as a military organization that we are determined to pursue?

General WHITE. I think that the public imagination is being caught by this. I am not sure that they are fully educated. I think that is a matter of time. I thought it was years before the public was educated to the potentialities of aviation. I think the same thing will occur in space. I think that the military aspects of this thing are being thought through. It must be recognized that there is a great deal that we do not know. But we are trying to keep abreast of it. I think that we are today.

The CHAIRMAN. One more question: Are you satisfied with the effort that we are putting behind this program from a security viewpoint at this time?

General WHITE. Well, we in the Air Force, and I think all of the military services, always want to see technology move faster because we realize that it is from the area of new developments that our lifeblood stems. On that basis alone I would say that I would always like to see things move faster. There are limitations, technological facilitieswise, which have a bearing; but I think we are well on our way.

The CHAIRMAN. Thank you, General.

Now my thought this morning, in order to get through the witnesses, because we were not able to finish yesterday, would be to recognize Mr. McCormack, majority leader, and Mr. Fulton, minority leader on the committee, and then throw the thing open to any urgent questions and then proceed with the next witness, if that is satisfactory with the committee. If it is, I will recognize Mr. McCormack.

Mr. MCCORMACK. General, on the light side still, the matter that I would like to get information about, because the word "aerospace" is something new to me and I know that has significance from the Air Force angle, where was that coined?

General WHITE. Within the last year and by the Air Force, I am willing to add. I would like to explain it if you wish.

Mr. MCCORMACK. I appreciate that it was coined by the Air Force. I imagine within that space that any of these conflicts between the Air Force and the Army and the Navy in outer space would be very easily adjusted from the Air Force angle because everything then will come under "Aerospace."

General WHITE. Well, I do not think the conflicts are as serious as some people would like to make them, Mr. McCormack.

Mr. MCCORMACK. I noticed you stressed the word throughout your whole statement, so I assumed this morning there was some significance in this wording. Why not call it "space-aero"?

General WHITE. That is a little more euphonious, perhaps.

Mr. MCCORMACK. You notice I say "on the light side." I can see where it developed, however. We will see what the future holds as to the term "aerospace" and the claim for its jurisdiction. Of course, General, we hear an awful lot about the overall military strength of our country and that word "overall" is what most people overlook, but which interests me every time I hear any of our military leaders speak and also those in high positions in the Defense Department. I always find that word "overall" in there. That could be changed very quickly, could it not? In other words, suppose the Soviet Union perfected a military satellite that could be an effective military instrument before we did. That would change the whole overall picture, would it not?

General WHITE. It certainly would point to that area as something new which had very great potential and very great danger.

Mr. MCCORMACK. Is it fair to say our main retaliatory power—I do not say exclusive, I say main—is SAC?

General WHITE. There is no question about it. About 95 percent of the U.S. retaliatory power is in SAC.

Mr. MCCORMACK. Could you give me something that is not classified—all I know is what I read in the newspapers—as to how far the Soviet Union has advanced in perfecting the intercontinental ballistic missile, its reentry and so forth.

General WHITE. I am afraid there is not very much I can say on that subject in an open session.

Mr. MCCORMACK. We read a lot in the papers that they are a year an a half ahead of us, or something.

General WHITE. That is one of the difficulties but also one of the virtues of our free press. There are many speculations and I still think that those who have the official classified information should neither confirm nor deny it in an open session.

Mr. MCCORMACK. In any event, is it fair to assume that the American people in their thinking, and also for us legislators in our thinking, to assume that military power is relative, that the strength of our power is in relation to the military strength of a potential enemy?

General WHITE. If you limit it to military strength, that is true. Of course, national strength is more than the military side of it.

Mr. ANFUSO. In reference to what you have just said, Mr. McCormack, I should like to advise General White and the committee that Mr. Khrushchev has this day made a public statement, which I think should have a public response on our part. He has said that all of

the weapons we have, and he included those available to SAC, are all outdated. He says that they have enough rocket weapons to wipe out our entire coastline, as well as the coastline of our allies, and that we could never land in Soviet Russia. Now that is a very frightening statement made to the American public and I should like to hear something from you from which the public can get some reassurance.

General WHITE. Well, I have not seen the statement, sir. I believe you said it was made today. The only statement I would like to make is that we are in the midst of a cold war and that history teaches us while we must give some credence to what the Soviet leaders say, very frequently what they say is not entirely the truth.

Mr. MCCORMACK. On military matters?

General WHITE. I think on military matters as well as others.

Mr. ANFUSO. Do you think that our public will take that answer or be satisfied with that answer?

General WHITE. I would not think so entirely; no, sir.

Mr. MCCORMACK. Coming back to what I spoke of—I will use your phrase, the Air Force phrase, I know it will please you on this occasion, "aerospace"—there is nothing in the foreseeable future from a military angle that could be used in aerospace with effectiveness, so me have to rely pretty much on the weapons we have today and the improvement of them.

General WHITE. There is no question about that, sir.

Mr. MCCORMACK. And our retaliatory power is SAC?

General WHITE. About 95 percent lies in SAC?

Mr. MCCORMACK. Our military strength is conceived on massive retaliation.

General WHITE. That is correct.

Mr. MCCORMACK. You spoke of our overall strength, and our economic strength, but if we are defeated militarily our economic strength is conquered, is it not?

General WHITE. That is correct.

Mr. MCCORMACK. So we have to be very realistic and realize that our military strength is of vital importance in this period of the world's history.

General WHITE. There is no question about that, sir, and it is given grave consideration.

Mr. MCCORMACK. Those charged with the responsibility of government, whether they be military or executive, if they are going to err in judgment, it is better to err on the side of strength than on the side of weakness?

General WHITE. I think that is generally a good rule to follow; yes, sir.

Mr. MCCORMACK. Can you give us any idea whether the Soviets are perfecting a defense against SAC?

General WHITE. There is no question about their improvement in their defensive capabilities just as we feel we are countering it with improvement of our penetration capabilities.

Mr. MCCORMACK. Well, until we perfect some more retaliatory power, if they perfect the intercontinental missile before we do, so that it can be pinpointed, under the factor of ironing out the bugs, and so forth, and they perfect a good defense against SAC where the attrition will be too high, we would be in a bad position, would we not?

General WHITE. I am sure that is so.

Mr. MCCORMACK. Is that an improbability?

General WHITE. I consider it an improbability.

Mr. MILLER. Will the gentleman yield?

Mr. MCCORMACK. Yes.

Mr. MILLER. I may say for the gentleman's information, that the statement Mr. Anfuso used, at least in its translation read in the press by me this morning, Mr. Khrushchev used the word with his intercontinental ballistic missile that he could "pinpoint."

Mr. MCCORMACK. He said that the other day, too.

Mr. MILLER. Do you think that is significant or do you think he is just whistling in the dark to keep his courage up?

General WHITE. I think there is some of both there. I think they have some capability or are rapidly getting it, but I question, from what we know, that it is anywhere near as effective as he says it is. However, the fact that he makes this statement, which appears as something new to me, probably has some significance that we must weigh very carefully.

Mr. MILLER. But he has been known in the past to use words to keep up the enthusiasm and confidence of his own people where they have not quite met up—where time has not been able to prove that.

General WHITE. We have been having a great debate on our own defenses here. I imagine some of it trickles through to the Soviet people and your thought may very well be a valid one, that he is speaking for home consumption, though I doubt if home consumption means very much in that country under their form of government.

The CHAIRMAN. He has been known to exaggerate, though, has he not?

General WHITE. He certainly has.

Mr. MILLER. Do you think recently in Quemoy, where we armed the Chinese Nationalists with some Sidewinders, that the Chinese Communist Air Force is finding very good reason to exaggerate after they met Sidewinders being launched from planes that were supposed to be less efficient than theirs.

General WHITE. I think the Chinese Communists and perhaps the Russians themselves received a considerable shock with the rapidity with which we reacted and with the efficiency of our forces that were there—and by "our forces" I am including the Chinese Nationalists.

Mr. MILLER. Of course their first reaction was that this was a dirty trick, that this was not clean pool, to use the Sidewinders—going beyond the real realm of war.

General WHITE. I think it is also fair to state, sir, that the Chinese Nationalists had a considerable margin of air victory without the Sidewinders. However, the Sidewinders were one of the most spectacular victories in air history. It was not only the Sidewinders that showed the Chinese Nationalists were superior to the Chinese Communist Air Force in that particular area.

The CHAIRMAN. The Chair wants to say this: He wants to proceed in the regular order which would be to recognize Mr. Fulton and then afterward we will throw open the meeting for general questions. The general is here for general questions and we want to proceed with the other witnesses; however, after recognizing Mr. Fulton, the Chair will throw the meeting open to general questions from any members of the committee.

Mr. FULTON. We want to welcome you, General, and we feel that you, as well as the Air Force, are doing an excellent and spectacular job in your field. We in America appreciate your good work.

General WHITE. Thank you, sir.

Mr. FULTON. I would like to yield at this time to Mr. Walter Riehlman of New York, who is in his second term of seniority in the House, who will handle the questions on this side.

The CHAIRMAN. Wait a minute, the Chair is going to have to recognize the members who question in a regular order. I don't think you can take away from the Chair the right to recognize the members who will question. The gentleman can yield for a question. That is all right. Mr. McCormack did. But as far as recognizing him, the Chair will have to proceed along that line.

Mr. FULTON. In this case I am requesting the Chair to recognize the Republicans in reverse order of seniority, starting with Mr. Riehlman.

The CHAIRMAN. Well, we have no objection at all. We will proceed.

Mr. FULTON. The questioning will start with Mr. Riehlman.

The CHAIRMAN. That will make for confusion.

Mr. FULTON. I have listed them in order for you here, one, two, three, four.

The CHAIRMAN. But if you start the Democrats at the top and the Republicans at the bottom, I think that is a type of discrimination. I do not like discrimination.

Mr. RIEHLMAN. Will the chairman recognize me for just a statement?

The CHAIRMAN. How is that?

Mr. RIEHLMAN. Will you recognize me for a statement.

The CHAIRMAN. We will throw the meeting open for a question. I will recognize the gentleman for a question.

Mr. RIEHLMAN. May I say to our distinguished chairman, this is not something that I have requested. I am sure Mr. Fulton would know that I, as a junior member just coming on the committee, would not request the opportunity to take over the minority side in questioning a witness this morning because I do not feel I am entirely qualified to do that. I think it is out of the goodness of his heart, because the members at this end are the last ones to have an opportunity to ask a question. This is only in the way of explanation.

The CHAIRMAN. If I may say to the gentleman: We had only one witness and he was on all day yesterday. If the members did not have an opportunity to ask questions of this witness, I do not know of any way to arrange it because he was on until after 4 o'clock yesterday afternoon.

Mr. RIEHLMAN. May I say to the distinguished chairman, that I had an opportunity to ask questions and I had no argument as to that.

The CHAIRMAN. It would be my purpose later on when we get into these hearings to rotate. If the committee wants to start in reverse order it is all right with me and the Chair will take the last place to ask questions, but I do think, after 1 day of hearings and practically only one witness, it is a little bit early to complain about the delay in permitting some of the members to ask questions.

Mr. RIEHLMAN. Would the chairman permit—I hope that you understood my statement, I was not complaining in the least. I just

said that that might have been in the mind of Mr. Fulton when he suggested that the men at the lower end have an opportunity to ask questions.

The CHAIRMAN. Mr. Fulton is a grand man, we will get along with him.

Mr. RIEHLMAN. Well, I would like to say to General White that I think he has made a very interesting and outstanding statement before this committee. You have outlined the interest that we as Americans and the Department of Defense have in this new field. You have alluded to one thing in which I am very much interested, on page 4 where you say there is no question in your mind that we have the ability to attain our goals in space nor that we will attain them provided we keep clearly in sight and remain constantly aware of the dangers and detours through which duplication, indecision, and diffusion can lead us. Now my question is this, General: Do you have any knowledge of where there is duplication and indecision and diffusion at this time with respect to this program?

General WHITE. I am not making reference there to any specific thing. I am pointing up that this is expensive business, not only in terms of dollars, but in terms of scientific talent and that we simply cannot afford to go down blind alleys knowingly or to have duplication or to drag our feet on this.

Mr. RIEHLMAN. I am sure that is what this committee would be primarily interested in. We want to wipe away any indecision, duplication or diffusion in this great field of activity. We want to see it move forward. I was interested in your reaction to that sentence, whether you could pinpoint any instances where there might be indecision, duplication, and diffusion.

General WHITE. No, sir; it is a new business and I just want to make sure we are on the right track and I point up those possibilities.

Mr. RIEHLMAN. I do not have any other questions.

The CHAIRMAN. Any further questions from either side?

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. I would like to follow up the colloquy that you just had with my distinguished friend, Mr. Riehlman, in this matter of duplication, indecision, and diffusion. I think the money is important, the spending of money for duplications wrong, but to me the big thing is the waste of manpower, the waste of scientific know-how. We only have a limited amount of it, as much as we would like to think it is unlimited. Do you agree with that statement?

General WHITE. I certainly do, sir.

Mr. MILLER. Now then, has there been minor friction between the Air Force, the Army, and NASA, or is there a chance of that developing?

General WHITE. Well, I cannot cite any examples of minor friction.

Mr. MILLER. Well, major friction?

General WHITE. There are always differences of opinion on matters. Here again I am not citing any specific examples. To rule out the possibility of friction in the future would not be in accordance with human nature, but I feel that with the goals clearly set forth, with intelligent people exercising commonsense in furtherance of a really important and vital program, those things will be worked out.

I am confident we have the people who will manage this thing in the most efficient manner possible.

Mr. MILLER. We do not want to put a muzzle on anybody. That is the last thing we want to do in a scientific program where we have to go into a field as unknown as this. All people concerned with it have to speak out and maintain their position. But is the guideline sufficiently clear that one of the services is not going to go off on its own in the development of what it feels is a missile in its interest, whereas the overall good could be best measured by full cooperation with the other services?

General WHITE. I am perfectly certain, sir, that there will be no individual service interests carried out at the expense of the overall program.

Mr. MILLER. You know, General, some of us have felt from time to time that there has been this encroachment of one service on the other, and that it has not been in the best interests of national defense, but I feel that this program is altogether too big and too important to let that take place. Is the Air Force prepared to make its sacrifices for the good of the whole?

General WHITE. There is no question of that. I think a good example was the reorganization of the National Defense Department which had as one of its chief objectives the objectives you spoke of and I believe the Air Force was not compelled by any service in its support of the reorganization bill.

Mr. MILLER. You would not mind if I said I could get into an argument on that, but we will not bring that up now.

The CHAIRMAN. Any further questions?

Mr. ANFUSO. Will you yield to me for a question?

Mr. MILLER. Yes.

The CHAIRMAN. The Chair recognizes Mr. Anfuso.

Mr. ANFUSO. Following up my distinguished colleague from California, General White, in connection with those research and development matters that represent dual purposes in that they may be developed for peaceful purposes or for military purposes, do you believe these should be financed and managed by NASA jointly with the Defense Department?

General WHITE. Well, the law as presently written, whether the intent of Congress is being fully expressed or not, I can't say, but there is some latitude for interpretation in that matter. I feel that wherever there is a dual interest that people who will be in charge of these programs will be people of integrity and high motivation, and will carry out their duties with commonsense. I think that there will be no conflict. I think that the military where needed will participate in any of the programs where there is a military requirement.

On the other hand, a great many of these programs will be purely civilian, and I have no question that intelligent men with a single good purpose will work these things out smoothly.

Mr. MCCORMACK. I think it is only fair to say, Mr. Chairman, as to any of these witnesses, your high motives are thoroughly appreciated by all of us. You are just as dedicated Americans as anyone else and we respect you and we know that you are giving your life to the service of our country and that goes to you and to all men in the service, so the question of motives is never involved.

Mr. ANFUSO. I might add to what Mr. McCormack has said that I, as I am sure is true of every member of this committee, have the highest confidence in all of our departments and that working together, I sincerely believe, that we will catch up with the Russians. The important question comes up, which did come up yesterday, and that is whether we are planning enough, whether we are doing enough. For example, we are inclined to assume, and I think some of the experts are inclined to assume, that we have enough retaliatory power, that some of the statements which come out of the Russians are whistling in the dark.

I am inclined to go on the assumption that most of the things that they say are true, for security reasons. For example, it is true today that the Russians have a satellite up there which is doing the work which we are planning to put in a satellite in the next 2 years to accomplish, is that not a fact?

General WHITE. On that order.

Mr. ANFUSO. So that is not boastfulness on their part, they are actually doing it. On the question of budget, that question was raised yesterday, and reading some of the newspapers this morning I think that the public is rather alarmed by the statement that there is not anything more that we can do. Do you feel, General, that there is not anything more that we can do? Do you think that we have done all the planning possible? Do you think that we have allocated all of the money necessary to catch up with the Russians?

General WHITE. I have to be guided by what our scientists say be-because I am not a scientist myself.

Mr. ANFUSO. Could I have an answer to that question.

The CHAIRMAN. What was your answer to the question, General?

General WHITE. Well, as to the budgetary resources, I am not qualified to talk on it. That is something that is in NASA and I think I would be out of my field if I commented on it because I do not know what their budget is at the moment.

The CHAIRMAN. Mr. Sisk, do you have a question?

Mr. SISK. General White, just one question:

Do you feel that either moneywise, budgetwise, organizationalwise or any other way that we are overemphasizing the peaceful application and use of space as compared to its military value today?

General WHITE. I think that our national aim to dedicate space to peaceful purposes is a very fine one. I also believe, as with many other things, such as disarmament, there are practical difficulties to doing that.

Mr. SISK. Well, the practical side of it is what I wanted you to discuss, in your opinion.

General WHITE. I think that it is possible by treaty and by other international instruments to make such agreements. Whether the Russians would live up to them or not is anybody's guess. But until we have an iron-clad or as nearly iron-clad an agreement as we can make to this effect, I am sure that there are military applications to space and that we must be prepared to fulfill those requirements.

Mr. SISK. Well, do you feel that we are overemphasizing peaceful applications at the present time—and by "we" I am speaking of the United States—to the detriment of possible military use of space?

General WHITE. No, sir; I don't think we are overemphasizing.

Mr. SISK. Thank you very much.

The CHAIRMAN. Any further questions?

Mr. CHENOWETH. I would like to ask a question.

The CHAIRMAN. I yield to Mr. Chenoweth.

Mr. CHENOWETH. You say in the future the decisive weapons will be aerospace weapons. How do you correlate that to our long-range bomber which we have now, which we felt was our most potent weapon?

General WHITE. I defined aerospace as a combination of aircraft, missiles, and space vehicles. The balance among them will depend entirely upon technology. As we advance, manned bombers may reduce in number as ballistic missiles become more perfected. I can see how even ballistic missiles may phase down sometime in the future when military space vehicles become available. The military mix is varying constantly according to the latest technology. I don't think it is possible, or, at least, I can't look into the future and tell you exactly what the changes are going to be. But take aviation again as an analogy: When it first started out, we thought very little of it. The military had no conception of what airpower would be. Now, airpower is the cornerstone in our national defense, from my point of view at least. I think the division of resources will indicate the emphasis which is placed on the various systems.

Aviation, in our opinion, includes the natural extension into space because our thesis is that space is merely a contiguous and uninterrupted medium to the atmosphere. The same aspirations that we have always had in flying, to go higher, to go faster, and to stay up longer, apply, even as you go out of the atmosphere into space.

So, now to say what the mix will be, I cannot. But I am sure that evolution is taking place. I can visualize some breakthrough in which revolution in military forces could take place. For instance, if we developed a satellite that had a military use, and a very spectacular military use, it might make every other kind of vehicle obsolete overnight.

Mr. CHENOWETH. You don't foresee that military use or application of the satellite?

General WHITE. I do foresee it as being possible.

Mr. CHENOWETH. You haven't any practical demonstration of it yet?

General WHITE. We have not yet had any practical demonstration of it.

Mr. CHENOWETH. You think it will come, however?

General WHITE. I think quite possibly it could come.

The CHAIRMAN. The Chairman recognizes the gentleman from Iowa.

Mr. WOLF. I am Leonard Wolf from Iowa. I have become extremely interested in this question of military preparedness in the past few months. When you answered Mr. McCormack you agreed our main deterrent to aggression is massive retaliation.

I have visted a couple of military bases in which they frankly took me to different departments and showed me where the key men in these departments was about to leave the service. Outside income was too attractive to hold him. They frankly said they didn't have anyone prepared to take their place.

I would like to ask you, if our main deterrent is massive retaliation, can our defense system work at full strength at all times when we recognize this condition?

General WHITE. We do have personnel problems. However, they are vastly improved since the pay bill came into effect. Our reenlistment rate has gone up. Our retention of officers has gone up. There are many other things that are needed to make military life as attractive as civil life sometimes appears to our technicians.

We certainly have our troubles, but we are improving, and the situation in my opinion is highly satisfactory at the moment.

Now, you could talk to——

Mr. WOLF. Well, that is what worried me into this position. I have done a little research on this thing, and I find even in the Air Force your reenlistment rate is very low, and the expense of training these people is considerable. I was wondering if you might want to enlarge on this question.

Would it be more efficient to pay even a little more for these key people, in the hopes we could be more certain to keep them because the pay is still very low, I am sure you will agree, General.

General WHITE. I do agree, and it is exceedingly expensive to have to retrain people all of the time.

Yes, there are several things that I think can and ought to be done. We ought to pay these people—we have thousands of officers and men on alert. SAC maintains a 15-minute alert on the ground. These crews live near their aircraft so they can reach them in a matter of a couple of minutes from their sleeping quarters. They don't leave for several days while they are in those areas. I am sure you have visited them.

Mr. WOLF. Yes.

General WHITE. Those men deserve special consideration. One of the ways we have compensated them in the past is that SAC has had authority to make what they call spot promotions. If a crew is thoroughly qualified and have what they call a target assigned, meaning that they are fully qualified to take out a certain target, then every member of the crew is given a spot promotion.

If they fail in their next test, they are demoted. It has a terrific impact on attaining peak efficiency.

As the Air Force as a whole is growing older, these higher ranks are beginning to be filled up, but we have a limitation on the numbers of officers that we can have in each of those grades. Therefore the spot promotions for SAC are going to have to be phased out or I am going to have to say that SAC is a special breed of cat, and that they deserve special attention. I can't in truth say that, because while they are exceedingly important, there are people in the Air Defense Command on alert also. There are tactical command crews on alert, ready to go on a few hours' notice, as they did to Lebanon and to the Pacific. You try to equate between a SAC crew that is on alert, an attack F–100 pilot who flies nonstop all by himself across the oceans and it is pretty difficult to say this man deserves a promotion and that one doesn't.

So there is, in my opinion, a very serious need for a means to continue with spot promotions.

Now in the case of others, there should be some pay, in my opinion, for this alert status. We have people all over the Arctic in early-

warning sites who live up there in absolute isolation, a couple of hundred men, supplied the entire year by helicopter only. There are just a great many things like that which have an effect on the morale.

I would say the morale is high, but nevertheless when an attractive offer comes from industry, many people give in and go, and you can't blame them.

So there are things that can be done, and in my opinion, should be done.

Mr. WOLF. This is a tremendous question, this question of retaining the top technical people, I know.

General WHITE. It is one of our key problems, sir. But I think it is fair to say that it has improved.

Mr. WOLF. Yes, I think that is true. I hope it improves a devil of a lot more.

General WHITE. So do all of us.

Mr. WOLF. Thank you.

The CHAIRMAN. Now, any further questions?

Mr. ANFUSO. Just one question.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. In line with the questions just asked by the gentleman from Iowa about personnel, Dr. Glennan said we are not working hard enough to train scientists. Do you agree with that?

General WHITE. Yes.

Mr. ANFUSO. Do you agree that the Air Force Academy at Denver——

Mr. CHENOWETH. Colorado Springs.

Mr. ANFUSO. Excuse me. Colorado Springs has done a lot in that regard?

General WHITE. Yes, I agree, but we haven't graduated our first class yet. That will be next spring.

The Air Force Academy is analogous to West Point and Annapolis. While it gives general cultural and scientific education, it is not a scientific school.

Mr. ANFUSO. Do you think a science academy is in order at this time?

General WHITE. I question that a national science academy is required. I think we have a great many civil institutions to which we can and do send our people. We have a great many officers and some enlisted men in scientific courses in many of our institutions throughout the country. Much more can be done in that respect.

Mr. ANFUSO. General, we have an awful lot of young men interested in science who don't have the means of entering any of our science institutes.

Don't you think if we had an academy similar to West Point, Annapolis, and also the Air Force Academy, dedicated strictly to science, that we could attract a lot of young men who would go into this science academy and in the future turn out to be great scientists?

General WHITE. That is one way to do it. There are other ways.

I think we can put more emphasis on science, but I think the emphasis should come lower down in the educational period. I think the problem is to get the grammar school and high school grade youngsters interested in the more severe disciplines. They are able to get credits now to graduate on what I would call the soft skills,

and it is there where we need to emphasize the scientific aspects, the mathematics, and all the rest of it, so they will be qualified.

The CHAIRMAN. General, we are planning special hearings on that subject later on. We have already talked with the staff about that.

Are there any further questions?

If not, let's get on with the witnesses, General.

We will call General Anderson, commander of the Air Research and Development Command.

You will be here with us for the rest of the hearing?

General WHITE. I will be here this morning, but I had not planned on being here this afternoon.

The CHAIRMAN. General Anderson, you are commander of the Air Research and Development Command. Where is your headquarters?

STATEMENT OF LT. GEN. SAMUEL E. ANDERSON, COMMANDER, AIR RESEARCH AND DEVELOPMENT COMMAND, U.S. AIR FORCE

General ANDERSON. My headquarters is divided. A very large proportion of it is at Andrews Air Force Base, outside Washington. There is where I am located.

I also have a division of the headquarters at Dayton, Ohio. That division manages the weapons and missiles programs with the exception of ballistic missiles.

General Schriever's Ballistic Missiles Division, located at Englewood, Calif., is also a part of my headquarters. Its job is to manage the ballistic missile program.

The CHAIRMAN. Do you have a prepared statement, General?

General ANDERSON. Yes, sir.

The CHAIRMAN. Do you have copies of it available for the members of the committee?

General ANDERSON. No, sir; I do not.

The CHAIRMAN. Then will you proceed with your statement and we will listen intently.

General ANDERSON. My purpose, sir, is to explain the organization of ARDC and its capabilities.

The mission of ARDC is to maintain the qualitative superiority of Air Force weapons. It follows that ARDC is therefore a scientific and technical organization and it has experience and facilities able to support—and I emphasize "support"—the space programs of our Nation, both military and civil.

This command comprises about 10,000 military and civilian scientists and engineers, and they are backed up by about 35,000 technical aids and support personnel.

This command has 1,900 contracts for basic and applied research in effect, and these are scattered throughout 249 universities or other nonprofit organizations in the United States.

We also have over 3,600 research and development contracts scattered throughout 1,100 industrial concerns.

I just explained the location of the headquarters, so I will skip that portion of the prepared statement.

We also have 10 major installations to carry out our program of research, development, test, and evaluation.

One of these agencies is called the Office of Scientific Research, and is located here in Washington. It directs our entire program of basic research.

Then we have the Air Force Cambridge Research Center near Boston, Mass. It carries on research in the area of geophysics and electronics.

We have the Wright Air Development Center at Dayton, Ohio, that carries out work in many technical fields. These include materials, structures, airborne electronics, rocket propulsion, electrical propulsion, aeromedicine, and other fields essential to support flight both in and out of the earth's atmosphere.

The Rome Air Development Center, located near Rome, N.Y., is engaged in the development of large ground electronic equipment for communications and for the control of flying vehicles.

The Arnold Engineering Center at Tullahoma, Tenn., provides a complex of wind tunnels essential to the study of propulsion and flight problems associated with both aerodynamic flight within the earth's atmosphere and propulsion and reentry problems associated with ballistic missile developments.

The Air Force Flight Test Center in California is the focal point of our aircraft flight test activities. It is located at Muroc Dry Lake in the Mojave Desert. The lake is about 5 miles long and about 13 miles wide, and it is firm enough to sustain the heaviest loads. It has been invaluable in the safe recovery of some of our aircraft and some of our test vehicles.

At this center we also have large rocket engine test facilities. One of the static test stands there, for instance, is capable of sustaining thrusts up to a million and a half pounds.

We have a Special Weapons Center at Albuquerque, N. Mex., in conjunction with the AEC facilities there in San Diego, and the purpose of this center is to marry all nuclear weapons to Air Force aircraft and guided missiles and to determine the most effective technique for their delivery on targets.

We have a proving ground center near Pensacola, Fla. This provides a well-instrumented range for the suitability testing of missiles and aircraft which are about ready to enter operational use.

We also have a Missile Development Center at Alamagordo, N. Mex., and it forms with the Army White Sands Proving Ground, just to the south of it, a missile test range which is about 100 miles long and about 40 miles wide.

This center tests comparatively short range missiles. Located there is also a 7-mile-long rocket sled track which is a facility for testing under high stress conditions many of the components of ballistic missles, in particular nose cones and guidance systems.

The Missile Test Center located at Patrick Air Force Base, Fla., is perhaps the best known of any of the centers of ARDC.

As you know, from Cape Canaveral, which is the missile launch site, the test range extends 5,500 nautical miles across the South Atlantic.

This center is supporting the test programs of the Army, Navy, ARPA, and NASA, as well as those of the Air Force.

ARDC is therefore an integrated operational organization for research, development, test, and evaluation; and we do undertake projects in support of the other Government organizations.

As ARPA and NASA have come into being, we have made these resources we have had available to them, and we have cooperated with them. In fact, I have directed unqualified support of these agencies, and in order to illustrate how ARDC works with ARPA and with NASA, I just wanted to mention one example of an order being performed for ARPA. This is for a high-energy, upper-stage vehicle.

For over 2 years prior to the formation of ARPA, ARDC, through a special projects office, have been developing a new type engine, aimed at an advanced weapons system. The techniques and some of the hardware were completed last year. When ARPA came into being, we briefed them on this program, and based upon the work we had already done, ARPA directed us to go ahead with the development of a high-energy, upper-stage vehicle, capable of putting greater weights in higher orbits. This work is being performed with very little change in our organization.

As of the first of this month, February 1, we have received a total of 25 ARPA orders. Some of these orders have several tasks under the one general order heading. The total value of these orders is $218,513,707. The Air Force has transferred to ARPA, at its inception, about $41,670,000. We are now performing six orders for NASA, with a present value of $25,501,000. The Air Force transferred to NASA $57,800,000.

I hope this discussion will bring out that the Air Force thinking and planning for military space developments has existed for several years.

The Air Force ballistic missile program, which got its present impetus in the summer of 1954, is the springboard from which our present capability derived.

The Air Force Research and Development Command is responsible for developing and testing the Atlas, the Titan, the Minuteman, and the Thor ballistic missiles. Their program is managed by the Ballistic Missile Division, but I would like to emphasize that located with the Ballistic Missile Division are major elements from two other Air Force commands. One is the Air Materiel Command's representatives there. These people, although located physically at Englewood, report directly to the commander of the Air Materiel Command, and they have the authority to speak for him on all ballistic missile matters.

Further, they do all of the contracting for ballistic missile development, testing, and procuring.

Similarly, the operating command, that is SAC, the command that will operate these missiles, is represented at Englewood by a special assistant for ballistic missile matters, and his purpose there is to insure that our development actions result in missiles which meet strategic planning requirements.

That is the end of my statement, Mr. Chairman.

The CHAIRMAN. Thank you very much, General.

I want to ask you a few questions.

We are happy to have you here.

Certainly, it is the first time you have been before this committee, which just began its hearings yesterday.

We have a lot to ask you, and we probably won't be able to do it today, because you cover such a wide field, with 3,600 contracts there

and 249 universities which are doing work for your command, 10 major installations you referred to, and then some incidental installations. You have a wide range of activity, and undoubtedly much to attend to.

I want to ask you, though, generally along this line; Do you consider a ballistic missile a space weapon?

General ANDERSON. Oh, yes, sir.

The CHAIRMAN. So if there was any question, you wouldn't need the word "aerospace," you could simply say "space weapon"?

General ANDERSON. That is a new word to me, too, Mr. Chairman.

The CHAIRMAN. Your command is taking the lead in developing the ballistic missile, and it was testified in the Senate hearings that by July 1959, at Vandenburg in California, we will have a wing—or is it a squadron—of ICBM's in operation?

Now, it is not my purpose to find out when you are going to have them in operation, but it is the purpose of this committee to find out what some of the qualities of the operation of those missiles are.

If I ask you something you don't care to answer in open sesison, just pass it by, and we can take it up later. Are the qualities of those missiles such that we can reach from here to Moscow with them?

General ANDERSON. Mr. Chairman, I would like to make two observations. The first is that General Schriever is here and is going to testify, and he is better qualified to answer the missile question than I; and the second is I don't think we should answer that question in open session, sir.

The CHAIRMAN. All right, we will pass it by and take it up in executive session with General Schriever.

May I ask you this: What progress is being made with the Atlas and Titan missiles?

If you can give an answer to that in open session——

General ANDERSON. The progress has been on schedule with the Atlas. I can say that. It is on schedule now.

With the Titan, we have had a little growing pains since they put the first missile on the stand. It is certainly to be expected, I think, in any new weapon as complicated as this. We do hope and expect to fire one before too long.

The CHAIRMAN. Before too long?

General ANDERSON. Yes, sir.

The CHAIRMAN. That is the Atlas, sir. What about the Titan?

General ANDERSON. It is the Titan I referred to.

The CHAIRMAN. Not the Atlas?

General ANDERSON. No; the Atlas is on schedule and doing very well.

The CHAIRMAN. What about the Snark? We have abandoned the Snark, haven't we?

General ANDERSON. No, sir; not entirely. We have procured or are procuring, rather, one Snark unit to be located in Maine, but we have abandoned plans, as far as I know, to procure any so-called advanced Snark weapons.

The CHAIRMAN. So there would be no further development of the Snark weapon?

General ANDERSON. We are not working on any at this time in ARDC.

The CHAIRMAN. What about the Regulus?

General ANDERSON. That is a Navy weapon. So I read in the papers—I can't testify to the fact—that it has been canceled.

The CHAIRMAN. You can't testify for the Navy on that?

General ANDERSON. That is right.

The CHAIRMAN. Mr. McCormack says is that an aerospace weapon?

General ANDERSON. I think so.

The CHAIRMAN. Let me ask you, then, Can you tell us in open session anything about the qualities of the Titan that would be used at least in one base, in Maine, I think you said?

General ANDERSON. The Titan?

The CHAIRMAN. Yes.

General ANDERSON. No; it was the Snark which I referred to as being based up North.

I would prefer, Mr. Chairman, to talk about the capabilities and qualities of these weapons in closed session, if I may.

The CHAIRMAN. All right. I think you are correct. But can I ask you this question, then? We are proceeding on the assumption that if Russia feels that she is able to destroy this country, she will proceed to do so, and therefore we want adequate protection. Can you tell us anything about the operational features of the Russian intercontinental ballistic missile?

General ANDERSON. I actually have no knowledge on that, sir, direct.

The size of the satellites that they have put into orbit which we know about would indicate to me that they have higher thrust engines than we have.

Beyond that, I simply don't know what the characteristics of their weapons are.

The CHAIRMAN. If they had the higher thrust engines, you would naturally assume they had the higher thrust?

General ANDERSON. Yes.

The CHAIRMAN. Would that mean additional range, too?

General ANDERSON. It could mean additional range, not necessarily, but it could mean that, of course.

The CHAIRMAN. Now, is their range as long as our range, 5,500 miles?

General ANDERSON. I really don't know. They manage to keep things pretty well hidden, Mr. Chairman, whereas ours are out in the open.

The CHAIRMAN. Let me ask you this question, then: Are you satisfied with the progress you are making on the missile program, in the Department of the Air Force?

General ANDERSON. Mr. Chairman, that tempts me. I am never satisfied with the progress. I think we are doing well, but we do have troubles, and I certainly keep after them, so I have to answer I am not satisfied; but I think we are doing well.

The CHAIRMAN. I recognize Mr. Fulton.

Mr. FULTON. General, we are glad to have you here. I would like to have you put in the record at this point a comment on the use of the TIR, the Technical Information Reports, distributing technical information among the various services, and then I would like to yield to Mr. Chenoweth, of Colorado, for a question.

(The requested information is as follows:)

Technical information obtained from innumerable sources is collated by the Armed Services Technical Information Agency (ASTIA). This agency provides a central service within the Department of Defense for the interchange of technical information consistent with effective security in order to promote progress and economy in research and development and to prevent unnecessary duplication of such services. ASTIA receives, stores, and disseminates to other agencies and contractors of the Department of Defense both classified and unclassified research and development information of a scientific and technical nature.

Technical information reports, including intelligence reports, are primarily used in the Air Research and Development Command to: (1) keep abreast of both the foreign and domestic state of the art in scientific and technological areas affecting the ARDC mission and, (2) search for technological breakthroughs in difficult or "blank wall" areas which U.S. technology has not yet penetrated.

Comprehensive utilization of technical information reports is encouraged, and such reports are made available on a need-to-know basis to military and civilian scientists, engineers, technicians and other specialists throughout the command, and civilian contractors holding U.S. Government commitments under the sponsorship of the Air Research and Development Command.

Mr. CHENOWETH. General, I would like to know something about your budget that covers all of these activities that you have mentioned here in detail. What is your overall budget?

General ANDERSON. The overall budget in the 600 area, which is the research and development area, for fiscal 1959 is—I think this is correct, and I know it is correct within $3 million—$753.8 million.

Mr. CHENOWETH. Seven hundred what?

General ANDERSON. $753.8 million.

Mr. CHENOWETH. What is your budget for 1960, the next fiscal year?

General ANDERSON. $750 million.

Mr. CHENOWETH. Practically the same.

General ANDERSON. The same level, yes, sir.

Mr. CHENOWETH. There has been some criticism over the fact that perhaps we are not making money available fast enough for these scientific research programs.

Would you say that that criticism is justified? Are you spending all of the money that you have for the scientists and personnel that you have? If you had more, could you use more money?

General ANDERSON. Naturally, I asked for more money than I got, but I am only looking at one segment of the total Air Force budget.

I think we have a good program with what we have, but we could use more, of course.

Mr. CHENOWETH. You are spending twice as much as NASA. I believe they told us $345 million yesterday, and yours is over $700 million.

Mr. FULTON. $385 million, currently, $400 million next year.

Mr. CHENOWETH. Not quite twice. What other agencies would be engaged in this, any others?

General ANDERSON. ARPA.

Mr. CHENOWETH. What would their budget be?

General ANDERSON. I don't know. I am interested in what they give us. They have given us $218 million since they came into being.

Mr. CHENOWETH. I was trying to arrive at some overall figure of what we are spending on this program. Could you give us some idea of that, General?

General ANDERSON. Yes, I can give you almost exact figures. If you add in the other money which is appropriated and goes to Air Materiel Command but is spent on our programs, in this year of 1959 it comes to $2,781,100,000.

Mr. CHENOWETH. $2,781,100,000?

General ANDERSON. Yes.

Mr. CHENOWETH. And next year?

General ANDERSON. $2,722,600,000 for fiscal 1960.

Mr. CHENOWETH. You are spending less money in 1960?

General ANDERSON. Yes.

Mr. CHENOWETH. Why?

General ANDERSON. We are getting money to do things from ARPA, and we expect to do things for NASA, so actually the money we will spend overall will be more than presently.

Mr. CHENOWETH. You are talking about the overall program, aren't you?

General ANDERSON. No, just ARDC's program.

Mr. CHENOWETH. Oh, I was trying to reach the total overall figure of all of the agencies, just how much we are going to spend next year on this program.

General ANDERSON. I could get that for you, Mr. Chenoweth, but I don't have it right here.

Mr. CHENOWETH. Would you want to venture a guess?

The CHAIRMAN. The record will be left open for his statement on that.

(The requested information is as follows:)

The programed total Federal research and development expenditures for fiscal 1960 is $5.484 billion.

Mr. CHENOWETH. Would that run four to five billion, would you say?

Mr. ANFUSO. About $7 billion.

General ANDERSON. I believe that would be high.

Mr. FULTON. It is between five and six.

The CHAIRMAN. The Chair will say this: I had our counsel look into that, and they gave me the figure of $5.5 billion.

Mr. FULTON. That is correct.

The CHAIRMAN. I think that is substantially correct.

Mr. CHENOWETH. Of that amount, your agency will spend approximately half?

General ANDERSON. Just about.

Mr. CHENOWETH. I think that is all, Mr. Chairman.

The CHAIRMAN. If there are no further questions, Mr. Fulton, Mr. McCormack.

Mr. MCCORMACK. General, you and I have talked over the telephone several times, and we have had very pleasant relationships over the telephone, and I am glad to see you personally. I was interested in asking one or two questions.

In your statement I was interested in the fact that at one of your installations you have a stand capable of withstanding a thrust of a million and a half pounds. Would you elaborate on this?

General ANDERSON. This is a stand for testing of large rocket engines. We have long had the project of developing a very high-thrust, single-chamber rocket engine.

That, of course, is in the NASA area, and they have now taken over that project. But the stand is there, and it will be capable of testing this single-chamber rocket engine when it is perfected.

Mr. McCormack. What is the thrust power of it now?

General Anderson. Right now I think probably the highest it has gone is 360,000 pounds of thrust.

Mr. McCormack. That is in practical operation?

General Anderson. Yes.

Mr. McCormack. How long would it take, in your opinion, to develop it to the capability of a million and a half-pound thrust?

General Anderson. Well, that is a function of how much money and effort NASA puts into it. I don't know—may I ask a question here?

Mr. McCormack. Surely.

(Discussion off the record.)

General Anderson. Our program, as I recall it, called for 3 years' development. It has been taken over, as I said, by NASA, and I don't know whether they will fund it more adequately than we were able to do or less adequately or what their program will be.

Mr. McCormack. Will you state for the record what you mean by the capability of containing the thrust; just give that in layman's language.

General Anderson. I could give you an answer on that, but General Schriever can give you a better one.

General Schriever. Captive testing is testing the entire missile on a stand in a held-down condition, where we attempt to simulate all of the conditions in flight as best we can. In other words, we get test after test in this fashion, which increases greatly our confidence in the reliability of our flight test program.

Now, we also test individual engines. This is not called captive testing. This is called static testing of the engines themselves.

The Chairman. Won't you have a seat, General? You can help us very much with this problem.

Mr. McCormack. Well, this is now under NASA?

General Anderson. Yes, sir.

Mr. McCormack. No further questions.

The Chairman. Any further questions?

Mr. King. I didn't get the distinction between captive testing and static testing.

General Schriever. Captive testing is testing the complete missile; in other words, the missile and all of its parts, held down on a stand.

Static testing is what we have always we referred to as testing an engine as such on a stand.

The Chairman. Any further questions?

Mr. Sisk.

Mr. Sisk. General Anderson, I have two or three questions with reference to your organizational setup, and as I understand it, you sit generally as what would almost be the chairman of a board of directors here. You have a number of establishments and many people involved in these various groups.

I am interested, of course, in the organizational setup, how you control your program, how you control and police contracts to see that we are getting the most bang out of each buck we spend, and so on.

Let me ask you this first: Is there someone else in your organization that will be before the committee that should discuss this, or are you the man that these questions should be directed to, General?

General ANDERSON. I am the man they should be directed to, because, as you say, I am more or less chairman of the board. I have a deputy commander for research. I have a deputy commander for weapons systems. I have a deputy commander for resources. I have a programer. I have General Schriever, who is a deputy commander and also commander of the Ballistic Missiles Division, and I have General Hougan, who is part of the headquarters, a deputy commander, but who also commands Detachment 1.

Now, this detachment is made up of what we call WSPO's, weapons systems project offices, and for every system we are developing there is a project office charged with monitoring day-to-day progress on that particular system. That is what Detachment 1 does.

I have one other deputy commander who is also the commander of the Air Defense Systems Integration Division of my headquarters. This man's job is to manage the integration of all of the components of the Air Force part of the Air Defense system of the United States and see that they fit, that at least our part of it will work when and if it has to.

General Davis, the deputy for research, is here. I think if you are interested in how we manage the research portion of the work, he could best answer that.

Mr. SISK. Now, to go a little further, General Anderson, is your work all contracted out as far as the actual work, itself—that is, the research and development of specific instruments or specific pieces of hardware—and then you have specific groups who supervise and watch and police that operation. Is that true, or do you do inhouse research and development?

Let me ask you this, General Anderson, to pin this down quickly, because I realize we must move along. But let's take, for example, the development of the nose cone of the Thor.

Now, in the development of that nose cone, who did the work; where was that done?

General SCHRIEVER. That work was done in industry under our overall supervision in terms of setting general specifications. But General Electric specifically is the developer of the nose cone for the Thor.

Mr. SISK. They furnished the manpower?

General SCHRIEVER. That is right.

Mr. SISK. And the management that went into that was handled from where?

General SCHRIEVER. Well, GE provided the technical management for the development of the nose cone, and it was under our rather detailed supervision from the Ballistic Missile Division.

We also furnished a great deal of the test facilities, which are governmental test facilities, such as those used for the sled tests that were conducted at Inyokern. These things were developed by the Air Force, and so it has been a team effort. But GE is the company responsible for the development of the nose cone.

Mr. SISK. Let me ask you this. Frankly, what I am attempting to do here, General, is to compare to some extent the type of manage-

ment operation which you handle as compared to the arsenal-type operation.

Now, let's be frank. I am sure you know what I am getting at. And I am not critical of your type or the other type. But I think the taxpayers are entitled to some answers as to the cost of the development of these things.

What was the total cost, finally, as to the development of the nose cone of the Thor? What was the total cost in developing it to its present position? Can you give me that figure?

General SCHRIEVER. I can't give it to you off the top of my head. I can furnish you that figure.

Mr. SISK. There have been totals tossed around in public, as I am sure you are familiar, on the cost of developing that nose cone. I was curious to verify those figures with you gentlemen here today, because I would assume that those were figures that you would have at hand.

The CHAIRMAN. Will you furnish the figures, General, for the record?

General SCHRIEVER. Yes, sir.

(The requested information is as follows:)

The Thor nose cone development program resulted from intensive nose cone development program at General Electric Co. for the Atlas missile. Inasmuch as both missiles utilized the same nose cone, there is no way of proportioning development costs between the two missiles. Specific development application for this nose cone development program peculiar to the Thor missile cost $38.9 million.

General SCHRIEVER. I might also say that same nose cone also was used on the Atlas. It was used for both the Atlas and Thor missiles.

Mr. SISK. I might say I have been told that the cost of the development of that nose cone was approximately $300 million. I was curious to know if that is somewhere generally correct.

General SCHRIEVER. I can categorically say it is not correct.

Mr. SISK. It would be substantially less or substantially more?

General SCHRIEVER. Substantially less.

Mr. SISK. Those are questions, Mr. Chairman, that I don't think I will take up further time with. Later on I am interested in getting into some of the operational problems that we are confronted with in their type of management program, because I think it is something that the taxpayers of the country are entitled to know.

The CHAIRMAN. The gentleman from New York.

Mr. ANFUSO. I have just two short questions of General Anderson. I understood you to say, General Anderson, that you asked more money for your program. I gather by that statement that if you had gotten more money, you could have used it.

General ANDERSON. Yes, sir.

Mr. ANFUSO. Did you have to curtail any of your programing as a result?

General ANDERSON. Yes. We have established, particularly in the research area, projects in order of priority, and some of the lower priorities in the research area fell out. In the systems area we, in some instances, are going a little slower than we would like to.

Mr. ANFUSO. You could very well have used that money?

General ANDERSON. Oh, yes.

Mr. ANFUSO. May I ask how much in addition you asked?

General ANDERSON. This year, fiscal year 1959, I asked for $1,220.9 million.

Mr. ANFUSO. That was in addition?

General ANDERSON. No, sir; total.

Mr. ANFUSO. What was the difference? What was the amount cut?

General ANDERSON. We actually are getting, in the 600 area now, $753.8 million.

Mr. ANFUSO. That is a cut of $500 million or $400 million.

General ANDERSON. When my request reached the Air Force, they already had guidelines from the Department of Defense as to what figures they could ask for, so it was cut.

Mr. ANFUSO. Just one more question, Mr. Chairman, and then I am through: Do you think, Mr. Chairman, we could have, either at a public session or in private session later on, the comparative strength of Russia or the comparative knowledge of Russia in this research program?

The CHAIRMAN. Of course a great deal of that will be in executive session. But we already have that planned.

Mr. ANFUSO. Thank you, sir.

The CHAIRMAN. I can say to the gentlemen of the committee, we are going to have these hearings straight through as long as we can. Now, when we begin to call the members for the third time to come to a meeting, we will slow up the hearings.

Mr. HECHLER. I would like to refer back to the statement of General White that "it is often difficult to separate basic scientific research from military potential"and that "it is our thought in the Air Force that there is at this point in time little if anything in the area of basic space research, which may not have some degree of military application." General White further stated that "extreme caution must be exercised in areas wherein basic research might be mistakenly separated from urgent military requirements to the detriment of those military requirements."

I wonder if you or General White would draw the conclusion from this statement, or if we should draw the conclusion, that there are some aspects of basic scientific research that should be under Air Force control?

General ANDERSON. Draw the conclusion that——

Mr. HECHLER. Should we draw the conclusion or inference from this statement that there are some aspects of basic research that should be under Air Force control so they will be tied in more directly with military requirements?

General ANDERSON. My comment to that, sir, is that there are many aspects of basic research that are under Air Force control.

Mr. HECHLER. Should we draw the conclusion that the Air Force is handicapped by lack of control in any respect?

General ANDERSON. No, sir; I don't think you should draw that conclusion.

Mr. HECHLER. Thank you.

The CHAIRMAN. Mr. Roush?

Mr. ROUSH. I am Ed Roush from the State of Indiana, General. I would like to go back to the question raised by my colleague from New York.

Would you say that it is a fair assumption to state that our scientific program is behind our development and production potential? In other words, General, is it in our scientific program that we are slowing up? Is that the reason we are not able to catch Russia any faster?

General ANDERSON. No, sir.

Mr. ROUSH. I gather if we used more money for research, it would have enabled us to catch Russia faster if we were able to enlarge on our scientific research program.

General ANDERSON. That doesn't necessarily follow. Let's take our materials area, where we have both to develop new materials and also new ways of handling materials in order to develop some of the materials which will withstand high temperatures.

For example, I have been around looking at the development of some stainless steel honeycomb structures, and you find one place we were working on bonding these by brazing and in others bonding by welding. That is the kind of thing we would spend money on. That is just one example of very many.

Mr. ROUSH. That is in the research field?

General ANDERSON. Well, it is technical development. We have basic research and applied research. It is basic when we don't have a particular application in mind. It is applied when we have a particular application in mind. This would be applied research, because we certainly have in mind an application for this kind of stainless steel honeycomb construction.

Mr. ROUSH. Thank you, General.

The CHAIRMAN. Any further questions?

If not, thank you very much, General.

You will be with us here? You are not leaving immediately, are you?

General ANDERSON. No, sir; I will be here.

The CHAIRMAN. As we hear General Schriever, if you could be here available, we might have to call on you for some of these questions.

General ANDERSON. I will be here.

The CHAIRMAN. You made an excellent witness. We are intensely interested in what you have to say.

General ANDERSON. Thank you, Mr. Chairman.

The CHAIRMAN. We appreciate your comments.

General Schriever, do you have a prepared statement? I want to say we have known General Schriever a long time. He has done an excellent job in the Air Force, and I have heard him testify repeatedly, and I think he is a brilliant officer. We are happy to have you.

Mr. MILLER. Mr. Chairman, before we get into this, could we establish this: Should witnesses come prepared with statements sufficient for the members of the committee?

Mr. ANFUSO. I should think so, Mr. Chairman.

The CHAIRMAN. Our rules normally require that the statements be presented 10 days before the session at which they are going to be used. We haven't enforced that because the rules were adopted less than 10 days ago.

We are satisfied these gentlemen from the Air Force will give us the benefit of their mature judgment.

Mr. MILLER. At other committees their aids brought up the statements and distributed them to the committee. I don't see why that

can't be done here. It is very hard to follow some of these things. I don't criticize these people, but a man knows 6 hours in advance what he is going to say, and they can certainly have them mimeographed.

The CHAIRMAN. The gentleman from California has followed me from the Armed Services Committee, and there they do pursue that sort of practice.

General Schriever, if you have a written statement, I know that the members of the committee would like very much to have a copy of that statement to look over at their leisure.

The same reference would apply to General Anderson's statement, if you could have them mimeographed, either the Air Force could attend to that or the committee——

Mr. MILLER. General White's statement was mimeographed. I don't see why the others weren't mimeographed.

The CHAIRMAN. That would apply to you and General Anderson. I know the committee would like to look at these statements at their leisure. It would be a very great help to us.

STATEMENT OF MAJ. GEN. BERNARD A. SCHRIEVER, COMMANDER, BALLISTIC MISSILE COMMAND, U.S. AIR FORCE

General SCHRIEVER. Mr. Chairman, I will be very happy to do this. I was asked to come in and give a very brief presentation on our ballistic missile program, and I had not prepared a statement. I had prepared a few notes, which I will, I think, follow and cover in what I have to say.

The CHAIRMAN. I understand you expected a large part of your testimony to be in executive session.

General SCHRIEVER. It was intended, as I understood it, to be a presentation, a briefing, regarding the status of our program.

Mr. FULTON. May I join with the chairman in welcoming General Schriever? We think you are a fine officer, who has done an excellent job.

General SCHRIEVER. Thank you. I am happy to be before the committee again.

If I might take a few minutes to cover what I have to say before the questions, I think this might answer a few questions.

First of all, my responsibility under General Anderson is as commander of the Air Force Ballistic Missile Division. We manage the development of all of the Air Force ballistic missiles, plus a certain amount of space work, which we do under the auspices and supervision of both ARPA and NASA.

I would like to cover briefly a description of the status of our ballistic missile program. I would also like to give you some idea or indication of how the ballistic missile program resources contribute and are available to this country for a space program, and then an idea of the potential of some of these resources, looking a little bit into the future.

I think it is pertinent to bring out one thing concerning certain features of our organization. General Anderson covered one aspect when he said we had three major commands represented in one physical location—the Air Research and Development Command, the Air Materiel Command, and the Strategic Air Command.

This is a rather unique organization as far as management goes. There are certain other features which have been our guidelines since the beginning of our program on an accelerated basis back in 1954. These have provided a carefully planned program to create a revolution in technology after a late start.

Now, Dr. Bradbury, who is a member of the original committee—the Strategic Missiles Evaluation Committee—which made recommendations to the Air Force to accelerate its ballistic missile program, stated in those days that we were undertaking a program of great complexity, even more complex than the atomic weapon program, or Manhattan project, during World War II. Secondly, the committee recommended that we design our missile systems to attain the greatest capability in the shortest period of time. In other words, our aim was to get an operational capability in the shortest period of time.

Now, we have been funded adequately for our development program since the very beginning, that is, back in 1954, and we have been given the necessary national priorities. There has been established in my organization authority sufficient to carry out the program, and we have carried it out aggressively. We haven't been timid and we haven't been frightened by an occasional failure. These we expect to have in any development program.

I might say in terms of progress against time that the Atlas shot—Project Score—which was the orbiting Atlas, happened just 4 years after we really laid down the foundation for that program.

On the Thor program, which is the intermediate-range ballistic missile, we fired the first operational version from operational equipment at Vandenberg Air Force Base just a week less than 3 years after we laid the program down.

So I think that it is fair to say that we have been pursuing these programs very aggressively.

Let me just take a few moments now to describe the four ballistic missile programs that we have.

This is the Atlas [indicating], which is the first ICBM program undertaken. We have had 19 flight tests of the Atlas. More than half of these have been completely successful, and from most of the others we have received very valuable development information. We have had a full-range demonstration flight, which occurred in late November, and of course the satellite flight I just mentioned.

The CHAIRMAN. What do you call full range, General?

General SCHRIEVER. 5,500 miles was our objective for this particular missile, 5,500 nautical miles. We expect to have the beginnings of an Atlas operational capability before, or rather around, the middle of this year, June or July.

The Titan program is just beginning its flight test phase. We have had several technical difficulties at Patrick. These always occur during the initial phases of a flight test program. I do not have a model of the Titan here because it is still classified, but it is a two-stage system. We expect to get our flight test program underway almost immediately.

The CHAIRMAN. What is your capability there and range?

General SCHRIEVER. This is also a 5,500-mile missile. However, it is a missile that has greater growth potential. It started about 1 year

later as a competitive and also a parallel program to theAtlas. Both of these missiles, incidentally, have considerable growth potential, both for increased range and for increased payload capacity. This, of course, is also a very important factor as far as space work is concerned.

The CHAIRMAN. One of the members asked me to ask you this question: Do they parallel, or why do you have both an Atlas and Titan program?

General SCHRIEVER. I would rather cover that in executive session this afternoon. I would be glad to do that, but you do have to go into some detail.

The Thor program, which is this missile [indicating], is a single stage, single-engine weapon. I might say that this particular engine [indicating], which has 150,000 pounds of thrust, stems from this booster engine for the Atlas. In other words, they are essentially exactly the same components put together in a slightly different way from a plumbing standpoint. So that we have a single engine with the Thor. This is designed for 1,500-mile range. The Thor is being deployed to the United Kingdom now, and we are in the process of progressively turning the First Squadron over to the RAF as the checkout and installation of the First Squadron is completed.

Mr. MCDONOUGH. That one is in multiple production at the present time?

General SCHRIEVER. It is in production. I do not know just what you mean by multiple.

Mr. MCDONOUGH. It has passed experimental stage and it is now in practical operation.

General SCHRIEVER. It has passed experimental stage or development stage in terms of proving out its performance characteristics. We continue our test program for some time to improve reliability. Both our test vehicles and our operational missiles do come from the same production line.

The CHAIRMAN. How many of those do you have? Is that classified?

General SCHRIEVER. That is classified, yes. I can tell you how many we have launched. We have launched 32 Thors to date.

Mr. MCDONOUGH. Where are those launched?

General SCHRIEVER. All except one have been launched at Cape Canaveral, but we are now starting our training launches from Vandenberg Air Force Base in California. That is where we are doing all of our crew training and unit training, both for the IRBM and the ICBM.

Mr. FULTON. And those missiles have reached operational level. How many of them have been successful, what percentage?

General SCHRIEVER. We have only fired one in the truly operational countdown, and that was a highly successful flight, and I might say that the missile is designed for a 15-minute countdown. You hear about these long countdowns at Cape Canaveral, which is true, but those test missiles are loaded down with instrumentation at Cape Canaveral. The operational version does not have that in it. All of the operational equipment was designed to be automatic for the countdown. The first missile fired at Vandenberg went through a 19-minute countdown. We were 4 minutes over our ultimate ob-

jective of launching the missile in 15 minutes, and were highly pleased with that performance. We have equipment at Sacramento on which we are running through countdowns daily, and we have had a high number of successive countdowns right down to the point of pushing the launch button which have been right in the 15 to 17 or 18-minute region. So we feel that we are getting a high degree of reliability in the operational equipment.

The CHAIRMAN. Have you finished your statement, General?

General SCHRIEVER. No, I have not finished my statement.

The CHAIRMAN. Suppose you finish your statement and then we will proceed to questions.

General SCHRIEVER. I would like to go into what we consider a second generation program, the Minuteman, which is a solid propellant ICBM. This particular missile has some very outstanding advantages over the first generation in that it will be simpler, easier to maintain and operate and it will also have an inherent capability to be mobile. We are studying a mobile concept for that particular missile now, in addition to hardening and dispersion. One other thing I know all of you and our taxpayers will be happy about: We consider the Minuteman to be an economic breakthrough in that, at least for the first time since the end of World War II, it looks as though a weapons system instead of being more costly will be considerably less costly than its predecessor. So the Minuteman looks to us to be an extremely promising development. I want to stress, however, that it is a development program. Its operational readiness date is not competitive time-wise to the missiles that you see here.

Now I would like to say just a few words about the foundation which the ballistic missile program has provided for space development. I said sometime ago, and it still stands, that about 90 percent of the resources required during the next 5 to 7 years for space work will come from the ballistic missile base. Just as an example: The Pioneer shots (the Air Force and Army moon shots) used the Thor and the Jupiter as the booster. The Atlas performed the satellite orbit I mentioned earlier. The Thor is the basic booster for the Discoverer series of shots which are scheduled from Vandenberg Air Force Base and which are imminent. The Atlas will be the booster for the Sentry. In addition, almost all the deep space probes (the radiation shots, the navigation shots, and things of that nature) will use the hardware from the ballistic missile programs, not only the hardware but also the launch facilities. I think it is fair to say that the Nation is fortunate that we did start an all-out ballistic missile program back in 1954 because it has given us a very good base for proceeding with an aggressive space program. As a measure of these resources, just in the Air Force ballistic missile program alone, we have put in more than a half billion dollars in new resources. These include research and development, test, and industrial facilities nonexistent before the past 4 years. We have established a very large base of experience in this country, both in Government and in industry. It is a very large program. Our ballistic missile program today exceeds $1 billion a year in terms of total effort measured in dollars. I think, therefore, that a very aggressive program in space is possible, and I think that we will be seeing a great deal accomplished during the next few years. And it will stem largely from the resources that

have been provided by the ballistic missile programs during the past 4 years. This is all that I need to say in terms of a presentation. I will be glad to answer any questions.

The CHAIRMAN. General, I want to ask you two or three questions. In reference to the Minuteman program, what is your target date for an operational Minuteman?

General SCHRIEVER. Mr. Chairman, that is classified, of course, but I would be very happy to give you that this afternoon and show how all of these missiles fit together in terms of a total program.

The CHAIRMAN. Well, let me ask you this: My mind seems to be dwelling on classified questions but in reference to your program now, do we have missiles that will carry from here to Moscow accurately?

General SCHRIEVER. We do not have an operational capability today, no, sir.

The CHAIRMAN. Do the Russians have such a capability in the reverse order?

General SCHRIEVER. I wish I knew. I really can't say, sir.

The CHAIRMAN. Well, you do not know that the Russians do.

General SCHRIEVER. I do not know that they do, and I do not know that they do not.

The CHAIRMAN. When will Vandenberg be in operation?

General SCHRIEVER. Well, it is in operation now for training purposes and for the Discoverer launches that I mentioned. From an operational standpoint it has a dual mission; it actually has a triple mission.

There is certain development work to be done there, training work, and then operational capability. Our target date for a start, that is our initial operational capability, is in July of this year.

The CHAIRMAN. Vandenberg is the base from which you are operating your program for return of the ballistic missile into the atmosphere. Is that not correct?

General SCHRIEVER. The Discoverer program will be launched from there, sir. If you are talking about ballistic missile and reentry tests——

The CHAIRMAN. Reentry.

General SCHRIEVER. Those have all been conducted from Cape Canaveral.

The CHAIRMAN. They have?

General SCHRIEVER. Yes.

The CHAIRMAN. I thought I saw something in the paper with reference to the reentry test being out over the Pacific.

General SCHRIEVER. We have some recovery tests in connection with the Discoverer program. We are carrying out that program under the supervision of ARPA.

The CHAIRMAN. That is different from the reentry test?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. Is there anything you can tell us in open session with reference to the recovery tests that you are making?

General SCHRIEVER. Well, the recovery tests are designed to—well, as Mr. Johnson pointed out in his press conference recently, we have several animal shots and of course, we have to bring them in a vehicle at a much lower deceleration than the reentry of a nose cone. We are attempting to develop techniques for recovering the vehicles. You

want to recover each of these, which necessitates equipment to let us know where it is, and actually give it signals to start it down from orbit. These satellites have many applications, and certainly the results of these tests will be very helpful to the man-in-space program, for example.

The CHAIRMAN. Well, they will depend upon your reentry tests, too, will they not?

General SCHRIEVER. Yes, sir. Much that we have learned in our reentry tests is directly applicable to our recovery program.

The CHAIRMAN. Well, your progress is dependent upon the progress of the reentry tests also.

General SCHRIEVER. Not entirely, sir, but again I would say that much of the data, both from flight tests, experimental tests, and wind tunnels, is very useful to the recovery program.

The CHAIRMAN. What is the pleasure of the committee? It is 5 after 12 now. Could you gentlemen be here this afternoon?

General SCHRIEVER. Well, I am scheduled to be here, yes.

The CHAIRMAN. We will run for 5 more minutes and then we will adjourn until 2:30. I say that because we have an executive session this afternoon and it will probably be a lengthy session. We cannot hope to finish this morning, so we will run for 5 more minutes. I will recognize the gentleman from California, Mr. McDonough.

Mr. MCDONOUGH. General, will you give the committee the primary lesson in the purpose of a countdown and what does 1, 2, 3, and 4 mean?

General SCHRIEVER. It means seconds before missile launch, and when we get down to where we start counting everybody gets real nervous. Actually during countdowns we are checking out everything in the missile which has to operate properly. Countdowns at Cape Canaveral are all personally conducted. The operational countdowns are all done automatically with electronic equipment which just checks in a second the job which takes minutes to do in a manual way. Of course, we have a tremendous amount of instrumentation. We measure pressure, temperatures, vibration, that sort of thing. These missiles are costly and we try to get the maximum amount of information we possibly can from each of them. We have many channels of telemetry on these missiles. It just takes a long time on a research and development countdown to get the missile off and be sure everything is right when you get it off. Of course, the fueling and so forth is all performed during a countdown. I might say that in the operational countdown, the short one I mentioned, the missile starts out completely dry. It is not loaded with fuel. The countdown includes actual fueling and——

Mr. MCDONOUGH. One to two is not 1 second.

General SCHRIEVER. No, sir; when you go down you go 10, 9, 8, 7, 6, and so on, and engine ignition occurs when you reach zero. You see, the flight time, the engine burning time, on these missiles is relatively short and we monitor it closely.

Mr. MILLER. But the countdown is the time you prepare the missile for launching in, and that may take an hour or 6 hours or 15 minutes; is that correct?

General SCHRIEVER. Yes. Normally our countdowns during research and development are a matter of several hours.

Mr. MILLER. If you decide you are going to fire a missile at 7 o'clock in the morning, you start checking it at 4 o'clock in the morning, but it does not mean the actual 10 seconds before you fire it?

General SCHRIEVER. No, sir. We have a book so thick [indicating] that we go through during an R. & D. countdown, and as each page is turned for each step down the line there is a check made.

Mr. MILLER. I assume the term comes from the fact that you generally start in 10 or 20 seconds before you actually fire and you count down by seconds and so you apply that to the preparation of the mission.

General SCHRIEVER. Probably so. That is the dramatic aspect of it.

Mr. MCDONOUGH. Well, if you were engaged in warfare you would not take all of this time to prepare, would you?

General SCHRIEVER. No, sir, that is why I was telling you that with the operational equipment—the demonstration flight that we made with the Thor at Vandenberg—we were extremely pleased, because with our 15-minute goal we made it in just over 19 minutes on the very first actual firing.

Mr. MILLER. May I ask this: Is that with the missile in place on its stand?

General SCHRIEVER. The missile is lying there inert. All of the equipment is designed to operate automatically but the missile is not fueled, nothing is operating on the missile when you start and 15 minutes later it is off.

Mr. MILLER. But your fuel trucks and all that are in position before that 15 minutes?

General SCHRIEVER. Well, we do not operate with fuel trucks. It would take you hours to get a missile off it you had fuel trucks. We put fuel and liquid oxygen into these missiles under very high pressure. It is blown in.

Mr. MILLER. The containers that it is brought up in must be brought up.

General SCHRIEVER. The fuel and liquid oxygen is in place.

Mr. MILLER. You can erect the missile, though, get it ready for firing in 15 minutes.

General SCHRIEVER. We have not quite made 15 minutes yet, but we are getting close.

Mr. MILLER. Well, that is your target.

Mr. MCDONOUGH. General, can you inform us as to how close we are to using this type of defense and finding it unnecessary to use SAC as a defense?

General SCHRIEVER. These are SAC weapons.

Mr. MCDONOUGH. Then they are supplementary to SAC. We still retain SAC with these.

General SCHRIEVER. Well, SAC is operating Vandenberg Air Force Base, for example. All of the ICBM bases that are being built in this country are under the Strategic Air Command.

The CHAIRMAN. This is a basic part of SAC, is it not?

General SCHRIEVER. Yes.

Mr. FULTON. It is one of SAC's weapons systems?

General SCHRIEVER. Yes. As General White pointed out, we depend upon our bomber forces now, but we are beginning to supplement them in the very near future with this type of weapons system.

It performs a strategic mission, and in time the balance will probably go over to the missile rather than the manned bomber. I do not know when that time will be, but for the foreseeable future we will have a mixed force.

Mr. McDonough. What has been your most difficult problem to overcome, guidance or propulsion?

General Schriever. Well, theoretically at first our most difficult problem was the reentry, but our tests have proven that that was not quite as difficult as we had thought it would be. We simply had not operated in the high velocity regions encountered during reentry of an ICBM nose cone. Actually I would say if I had to pick one single system that has been the most difficult, it has been propulsion. Not in the sense of getting the performance, but rather in the sense of getting the degree of reliability that we want. Because this is a system that operates on very narrow tolerances, and has a lot of plumbing, valves, and so forth, many little things can go wrong, and it usually is a little thing that goes wrong.

Mr. McDonough. Well, what accuracy have you established as far as target hitting is concerned?

General Schriever. Well, this is also classified. I will be glad to tell you that this afternoon.

Mr. McDonough. Well, maybe you can answer it this way: Has your propulsion or your guidance been your biggest difficulty in hitting the target?

General Schriever. Well, if your propulsion fails in any way, of course you do not hit the target. Our guidance I might say has performed very well. As a matter of fact, we have attained our goals in our guidance.

Mr. McDonough. We are talking about a 1,500-mile missile now, are we not?

General Schriever. We are talking about both.

Mr. McDonough. And you spoke about the maixmum trajectory of the Atlas at 5,500 miles.

General Schriever. 5,500 miles is the range.

Mr. McDonough. How accurate were your shots on that? Is that classified also?

General Schriever. Yes, sir.

The Chairman. Gentlemen, we have continued in session 10 minutes. If there is no objection, it seems to me the best thing to do would be to adjourn until 2:30. We have two or three members right now who want to ask questions, Mr. Karth, and Mr. Osmers. They will be the first ones to be recognized at 2:30.

Mr. Fulton. Could I finish with something as to Mr. McDonough's comment? Actually it is "Four, three, two, one, and having been at Cape Canaveral it is four, three, two, one, whee," or "Four, three, two, one, damn," is it not?

General Schriever. Just about that.

The Chairman. 2:30.

(Whereupon, at 12:15 p.m., the committee recessed, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

The committee met at 2:30 p.m., in room 219, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will please come to order. Now, we have a good deal of testimony yet to be heard. In fact, I have just been reminded by one of our staff that Mr. Allen F. Donovan, vice president and director of the Astrovehicles Laboratories, Space Technology Laboratories, Inc., Los Angeles, Calif., is here and he has come a long way to be heard and has a story that has not been told before. I know the committee will be very anxious to hear him this afternoon.

I mention that to you so that we can get along as rapidly as possible with our testimony.

When we closed at noon, General Schriever was testifying. Would you have a seat, sir, where you were today at noon and make yourself comfortable. I promised at that time to recognize two members of the committee to be heard. Are either one of them here?

Mr. KARTH. Mr. Chairman.

The CHAIRMAN. The Chair will recognize Mr. Karth at this time.

Mr. KARTH. General Schriever, my name is Joe Karth, and I am from Minnesota's Fourth District. I had one question and it is in line with the chairman's question of you earlier today. I was quite interested when he asked you whether or not you knew if Russia had an intercontinental ballistic missile that they could target into the United States from Moscow. You said you did not know that they had one or you did not know that they did not have one.

My question now is: Do you have any information that leads you to believe that they might have one? You used the word "know," in a positive sense.

General SCHRIEVER. This would be purely speculation.

Mr. KARTH. Would you give me your opinion?

General SCHRIEVER. My opinion based on what I do know is that they do not have an operational missile.

Mr. KARTH. Then I understood you to say this morning, and perhaps I was in error——

General SCHRIEVER. Well, let me clarify or qualify what I said. I said from what I do know I do not think that they do. What I am really trying to get across is that I do not know that we know everything they are doing. We have an open curtain here in the United States. They know exactly what we are doing. I just do not think that our information is adequate enough for us to say positively that they do or do not have an operational missile.

Mr. KARTH. Well, I am not asking you whether you can say it positively. I understand that you cannot, sir, and certainly I appreciate that viewpoint. I am just asking whether or not you have any information which leads you to believe that they might have an ICBM that could be targeted into the United States from Moscow.

General SCHRIEVER. They could have, yes.

Mr. KARTH. Thank you.

The CHAIRMAN. I might say to the gentlemen that there is an article in today's paper, which I have just read, in which the Secretary of Defense of Russia is quoted from Moscow as saying that Russia is ahead of the United States in all phases of the ballistic missile program and that, as a result, the shores of the United States are highly vulnerable.

Would you want to comment on that, General?

General SCHRIEVER. Well, I have not had a chance to really read the article. I would not want to comment on it specifically. I think this would be something that would also have to be covered in the closed session because it does involve intelligence information which I do not think we can talk about here in open session.

The CHAIRMAN. Mr. Fulton, do you have a question?

Mr. FULTON. Yes, I do. I would like to comment on this particular angle. As a matter of fact, General, we have many kinds of weapons systems of which the ICBM is simply one; is that not right?

General SCHRIEVER. That is correct.

Mr. FULTON. So that in the Strategic Air Command, SAC, of the weapons within its system, we have placed greater reliance on other weapons systems than ICBM because ours have not yet been perfected—on planes, on IRBM's, rather than ICBM's. I am trying to show that the ICBM is not the last answer.

General SCHRIEVER. Yes, it is not the last answer.

Mr. FULTON. So we are able to defend the United States and the free world and if attacked give a pretty good massive retaliation with a telling force in case of emergency.

General SCHRIEVER. I think that is true today, but we are also concerned about what is going to happen tomorrow, and when I say tomorrow I am talking about 2 or 3 years down the line. The decisions we make this year really dictate what kind of force we have 3 or 4 years from now.

Mr. FULTON. I think that is a good distinction because we should not have the people frightened of our present-day capability in viewing what might happen in the future. We should distinguish between the two and prepare adequate programs, is that not right?

General SCHRIEVER. That is correct. I think that as far as today is concerned I can go home with a reasonable amount of confidence that we are not going to be annihilated in the wink of an eye. But because I am in the research and development business and am looking ahead, I am very much concerned as we look down the road.

Mr. FULTON. As a matter of fact, on our advance bases—of which we have in the United States over 250—we are within an intermediate ballistic range of the Russians while they are still from their land bases at an intercontinental ballistic missile range. Intermediate range is 800 to 1,500 miles while the ICBM is maybe 3,000 to 6,000 miles, is that right?

General SCHRIEVER. Well, generally the ICBM's are identified as from about 4,000 to 6,000 nautical miles, in that region; intermediate range from 1,000 to 2,000.

Mr. FULTON. But we are preponderate with our bases. We not only have one or two ICBM's, but we can have them in almost broadside volley, with very little chance of interception, very little guidance necessary, and a preprogram flight, is that not right? It supplements our ICBM capability.

General SCHRIEVER. Are you talking now about the IRBM?

Mr. FULTON. IRBM. I said ICBM originally.

General SCHRIEVER. Well, when you get into the area of the IRBM, of course, there are so many factors involved that it is almost impossible to say just exactly what kind of force will be deployed overseas. It is beyond my level to give you an answer to that question because of the NATO and other political factors.

Mr. FULTON. Well, we on the Foreign Affairs Committee believe that we are adequately prepared in that field too, I would comment for the record, if you cannot answer on that end of it.

May I finish with this: The strategic area is expanding in what we call aerospace, so that it might be said for the protection of the United States at this time we almost have to have everything translunar, is that not right, between us and the moon?

General SCHRIEVER. I do not know that I exactly follow your question, Mr. Fulton.

Mr. FULTON. What is our strategic aerospace that now we must defend, or have the power or dominion to control, in order to protect the U.S. security. How far our does it go?

General SCHRIEVER. I think I follow you now. I think I can best answer that by saying that space from our point of view is another medium and when I say "space" in the immediate future I am talking primarily as to several hundred or several thousands of miles from the earth. It is another medium in which we can develop vehicles and systems which can do our mission better, just as land, sea, and air are mediums, and I think what you say is true, in the broad sense that in the more immediate future we are interested in anything between here and the moon.

Mr. FULTON. And in that particular field at the present time there is nobody that controls, neither ourselves nor the Russians, and it is really a strategic area that we should move into promptly, is it not?

General SCHRIEVER. I do not think that either the United States or the U.S.S.R. controls this medium. I think both nations are moving toward this in a scientific manner and, of course, there are many applications that we see as we look into the future for military systems.

Mr. FULTON. We do know that the Russians have had ICBM flights or shots, but the thing we do not know is their capability to spot them or direct them or to control them, is that not the case?

General SCHRIEVER. Well, let me say that I do not have information which allows me to answer that question in a positive way. In other words, I cannot say that we do know they can spot them to a specific point.

Mr. FULTON. Yes, but we do know that they had have the flights of the ICBM's, do we not?

General SCHRIEVER. We have information that they have had ICBM flights; yes.

Mr. FULTON. But these claims by Khrushchev and others, so far they are unsupported as to any information we may have as to their possibility of control, so they may just be expanding their heads a little bit by claiming they can go from Moscow to New York or pinpoint anything in this country. As far as we know, there is no practical way to instrument it, is that not right?

General SCHRIEVER. The answer to that is "yes," we do not.

Mr. FULTON. Thank you very much.

Mr. SISK. Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. General, I would like to ask you to comment on whether or not and if so to what extent your people are working on an antimissile missile because primarily, as I understand it, much of our defense is predicated on defensive type weapons, in addition, of course, to our retaliatory power, which after all, of course, is defensive also.

Now there has been no comment made on that at all, or can you in an open session make any comment on what you are doing in that field?

General SCHRIEVER. Not in detail. I can tell you in general. The Air Research Development Command has had an antimissile office as long as we have had a ballistic missile office. We have been studying all aspects of defense against ballistic missiles; this is not in my office directly, but we work closely with this office. This office is actually at Andrews Field, with General Anderson at his headquarters. We have been looking at all means of warning—advanced systems of warning. The Air Force does have the responsibility of developing a warning system against ballistic missiles which, as you all know, is the ballistic missile early warning system (BMEWS). It is in the process of being installed in the far north now. We are also looking at other means, and then, of course, we are looking at ways by which we might go from that into an active defense. As you know, at the moment the Army does have the direct responsibility for the active defense portion, and they are working primarily in the Nike-Zeus system.

Mr. SISK. Yes; I know as to that, and I was curious whether the Air Force was doing any research and development work along the same line that might be contemporary to this.

General SCHRIEVER. In a hardware sense we are not. We are conducting studies, and I might take my answer just a step further. In my office we have a section which adds another "anti" to the first "anti" (anti-antimissile), because we are interested in developing countermeasures to any defense system that might be developed. So from that standpoint alone we have a great interest in the possible defense systems that might be developed against ballistic missiles.

Mr. SISK. With reference to the discussion with the gentleman from Pennsylvania a few moments ago on the IRBM setup or such groups as are operational and so on: that is a direct responsibility of the Air Force and of SAC; is that right?

General SCHRIEVER. No, not quite. The Air Force has the operational responsibility for intermediate range ballistic missiles.

Mr. ANFUSO. Mr. Chairman.

General SCHRIEVER. Actually there have been two systems developed as you know, the Thor and the Jupiter, and the operational deployment of those is under the overall supervision of the Air Force. SAC plays a very vital role in that but the program calls for these units to be manned by personnel from whatever country they might be deployed in.

Mr. SISK. I appreciate that answer. Without getting into what what I am sure is classified information, I do not hold completely

with my colleague. I respect his judgment—that we are in a position, from other information the committee has had, to say that that represents a very strong arm of our defense at the present time. Due to what you mentioned about not only the location and deployment of the IRBM's but the people that are going to handle them and so on, I would assume there is a great deal of work to be done before we can say we have any specific defense.

Mr. FULTON. Will the gentleman yield?

Mr. SISK. Yes.

Mr. FULTON. I was putting it in the context of one of the types of weapons we are using on these advance bases so we have the opportunity for what we call a salvo in the Navy, along with various quantities of these. I do not mean they are in tremendous quantity at the present time.

Mr. SISK. I did not understand that we have any substantial defense at the present time. However, it is being worked on. It is another arm and another one of the things we are dependent on.

Mr. FULTON. Yes.

Mr. SISK. Thank you, Mr. Chairman.

Mr. HALL. Mr. Chairman.

The CHAIRMAN. The Chair recognizes Mr. Hall.

Mr. HALL. I am David Hall of North Carolina, General. In answer to a question posed by Mr. Karth, did his use of the word "operational" have anything to do with your answer? He asked you if you had reason to believe that the Russians had operational ICBM's.

General SCHRIEVER. Oh, yes, my answer was predicated specifically on his reference to "operational."

Mr. HALL. Then I assume you do believe that they have a missile in the development stage or in the testing stage that would bring a warhead to these United States, is that right?

General SCHRIEVER. Yes, sir.

Mr. HALL. Do you have reason to believe that they have any type of exotic fuel for propelling these instruments, or this hardware as you call it, that we do not have?

General SCHRIEVER. This touches on classified information.

Mr. HALL. We will get to that later, then. Do you have to believe the additional range they have achieved is from clustering the same type missiles we are using or are they single-stage and single-range instruments?

General SCHRIEVER. Are you talking about the range of their space flights, sputniks and that sort of thing?

Mr. HALL. I assume it makes no difference where the missiles are going to go, that you have to have so much thrust in order to get the instrument where you want it to finally arrive and if they have one that can arrive in or near the vicinity of the moon, they also have one they can get to the United States.

General SCHRIEVER. There is no question but that they have adequate thrust to get an ICBM to the United States.

Mr. HALL. All right, now, sir, the question is from whence does that additional thrust come, if that is not classified too, if you have reason to assume where it comes from.

General SCHRIEVER. Well, it is just from their normal development of rockets over a considerable period of time. We have adequate thrust——

Mr. HALL. In other words, their instruments are more refined than ours.

Mr. OSMERS. Mr. Chairman, would the gentleman yield for a moment?

The CHAIRMAN. Would the gentleman yield to Mr. Osmers?

Mr. HALL. Yes.

Mr. OSMERS. General Schriever is not an intelligence officer. He is commander of the Air Force Ballistic Missile Division. There is already a contradiction in the record based on his reply to one question about an operational ballistic missile and the question asked by the gentleman from North Carolina, Mr. Hall, that I think will show at one point General Schriever said they did not have it or he assumed, or something like that, and in another answer it made it appear as though he was saying that they did have it. It seems to me, with respect to information as to the enemy's capabilities, we should not discuss them too fully in open session and should wait and have them answered by intelligence officers behind closed doors.

The CHAIRMAN. My thought is this: I will say to the gentleman from California, that 50 percent of the questions seek to elicit information which is classified. We will get ahead much faster in this hearing if we will hear the final witness of the day in open session and then go into executive session and I think that the witness can speak more freely then. He will not be guarded in his answers for fear something he says might be classified and we can save the time of the committee.

I want to say this: Everything we can reasonably get to the press, I think the press ought to have.

Mr. TEAGUE. Mr. Chairman.

Mr. HALL. Mr. Chairman.

The CHAIRMAN. The Chair recognizes Mr. Hall.

Mr. HALL. That is exactly the purpose of my questioning. If you will remember, the only question that I asked yesterday of Mr. Glennan was whether or not they had a public information agency set up in his administration and he stated that they did. I have been reading the newspapers and every report I get is counter to every other report I get.

The President of the United States in his message to the joint session of Congress stated that the cost of these ballistic missiles was $35 million each. There was testimony yesterday or today, or in one of these reports, that the cost of these missiles was $31½ million or $2 million. What I want to do is to try to get the facts and get them before the public. I think that a great deal of the confusion that has come about has come about because of misinformation that has been put out by the various branches of the service and by the various agencies without any attempt to coordinate the dissemination of this information.

The CHAIRMAN. Let me ask this: What is the information you wish to elicit? Why do you not go ahead and ask the witness and we will hear him.

Mr. HALL. That is what I was attempting to do.

The CHAIRMAN. No one is trying to keep you from asking what you wish. My only plea is that we do have another very important witness and we do have an executive session and the sooner we get to it the more information we will get.

Mr. TEAGUE. Will the gentleman yield. I do not think the record should stand that there has been a contradiction, Mr. Chairman, because I do not think there has been a contradiction. If I understood the question from the gentleman from Pennsylvania, he asked if the general thought that Russia had operational missiles and he said that he did not know. The gentleman from North Carolina asked if they had an ICBM that could reach the United States and the general said yes.

I do not believe that constitutes a contradiction.

Mr. FULTON. I would agree with the gentleman.

The CHAIRMAN. I would too.

Mr. OSMERS. It seems to me again if we are going to put it on the record in open hearing——

Mr. HALL. Mr. Chairman, I believe I have the floor.

Mr. OSMERS. I will have to ask the gentleman from North Carolina to yield.

The CHAIRMAN. The Chair has recognized the gentleman from North Carolina. I will ask the gentleman from North Carolina to proceed with his questions and let us get along.

Mr. HALL. I will retain all other questions until we go into executive session, Mr. Chairman.

The CHAIRMAN. All right. The Chair recognizes Mr. Osmers, of California.

Mr. OSMERS. I am not from California.

The CHAIRMAN. New Jersey; I beg your pardon.

Mr. OSMERS. I just think, Mr. Chairman, that in the early days of our committee and in the very friendly and nonpartisan spirit in which you as chairman have approached these deliberations that we should not try in open hearing to peck away constantly at classified information, particularly from officers who do not have full access to it.

In reply to Mr. Fulton's question, as I recall, the question was did they have an ICBM that could hit something in the United States, or words to that effect, and I believe General Schriever replied he did not know whether they did or not. Obviously, anybody knows if you can shoot something into or by the sun, you might possibly get it to the United States.

Mr. MILLER. Will the gentleman yield?

The CHAIRMAN. The Chair will say this, if there is no objection: General Schriever will have full opportunity to go over his testimony and correct any feature or phase of it so that it will respond to the facts as he sees them.

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller from California.

Mr. MILLER. I realize that my good friend from New Jersey is quite a knowledgeable fellow, but I do not think that his conscience is Mr. Hall's conscience or my conscience.

Mr. OSMERS. Certainly not, sir.

Mr. MILLER. Then I am not going to tell you what you should do and how you should conduct yourself and the line of questioning you should carry on or even suggest that you are heckling the witness.

The CHAIRMAN. We are not getting anywhere, gentlemen.

Mr. MOELLER. Mr. Chairman, I ask the floor.

The CHAIRMAN. I recognize Mr. Moeller.

Mr. MOELLER. General, you made a statement a moment ago that disturbed me a bit and possible subsequent testimony will give the answer. Did you infer that possibly the Soviet Union's intelligence is better than ours or would you say in another way that we are too loose, too free with our information, maybe we have had too many foreign visitors here?

General SCHRIEVER. Absolutely not. Our democratic system does not permit an Iron Curtain. Theirs does.

Mr. MOELLER. But would you think that possibly the fact that their intelligence is advanced to the stage where we think it must be, that that in itself could contribute to our lag in this development?

General SCHRIEVER. No, as far as missiles go, I do not think so because I believe we have adequate evidence that they started on rocket developments on a large scale before the United States did. I do not think that our work was a stimulus to theirs.

Mr. MOELLER. I see. Thank you, Mr. Chairman.

Mr. ANFUSO. Mr. Chairman, I have one question.

The CHAIRMAN. The gentleman from New York.

Mr. ANFUSO. I would not like to leave this open hearing with the impression that we are going over a lot of top secret information or classified information because I do not think we have. I think that everything that has been discussed here, Mr. Chairman, has been well gone over in the newspapers and I think that everybody knows all about it, but I would like to correct this impression, and I think that the public should know it.

I think the impression has been left here that we have perfected an ICBM capable of hitting a target 5,500 miles away, which of course means Moscow, and that the Russians have not. If that is the impression left here in this open hearing and that is what we want to convey to the American people, I think it is wrong because I do not think it is true. It is my personal opinion that the Russians started this missile program way before we did and it is reasonable to assume that they are ahead. And I believe that they are ahead. And I will say this to the credit of the United States: we are doing a darned good job in getting ahead. My only point is to recognize the facts and then wait until we go from there, let us go full speed ahead. I think we will catch up with the Russians. I do not think the Russians are going to start anything right now because they are sure-shot people. They like to make sure everything is a sure-shot before they start and they are not too sure right now that we are not capable of retaliating in force.

That is all, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Mr. DADDARIO. Mr. Chairman, one question, please.

General Schriever, taking your entire program into consideration, to what have you assigned highest priority, what is your primary objective?

General SCHRIEVER. I happen to be in the happy situation where all of the missile programs that are under my control enjoy top national priority. I do not want to leave the impression that this gives me a blank check. I have to fight pretty hard for what we get in support of the program, but, nevertheless, we have gotten everything that we have asked for. The one program that does not at the present time enjoy top national priority is the Minute Man, but it does enjoy top priority in the Air Force. I might summarize by saying the ballistic missile programs under the Ballistic Missile Division have top priority in every respect.

Mr. DADDARIO. That means anyone of these various missiles you are talking about have the same programing, the same number of personnel behind them.

General SCHRIEVER. This boils down to matters of permitting overtime, extra shifts, cutting administrative redtape, the number of things involved in conducting programs of this kind, priority on materials, and things of that nature.

The CHAIRMAN. Any further questions? If not, I would like to ask you a question or two myself.

General, there was something said about the warning lines that we have in the northern part of the United States and in Canada and also on the Atlantic and Pacific. Of course, we have covered that pretty well in prior hearings, but let me ask you: As of this hour, are we vulnerable to bomber attack from Russia or is that warning system sufficient to allow us to say we are not vulnerable to a surprise attack?

General SCHRIEVER. Mr. Chairman, I would like to answer that, but this is really——

The CHAIRMAN. Is it classified?

General SCHRIEVER. It is out of my field and it is classified.

The CHAIRMAN. Now the Secretary of Defense in Moscow said today that our shores were vulnerable. What I would like to ask is in reference to whether he would mean bombers or missiles.

General SCHRIEVER. Well, I must assume that he means missiles.

The CHAIRMAN. That was my assumption.

General SCHRIEVER. That is right, ballistic missiles.

The CHAIRMAN. Mr. McCormack, you just came in; do you have any questions?

Mr. MCCORMACK. No, sir.

The CHAIRMAN. If not, we thank you very much, General. Now we have Mr. Donovan who is director of Astrovehicles Laboratory, Space Technology Laboratories, Inc., Los Angeles, Calif.

General SCHRIEVER. As I understand it, Mr. Chairman, his presentation was to be in executive session.

The CHAIRMAN. Very well. Is there any more testimony in open session?

General ANDERSON. General Boushey has a presentation.

The CHAIRMAN. Just come forward, General. We are happy to have you here today. You have been with this program a long time.

General BOUSHEY. Yes, sir.

The CHAIRMAN. Do you have a prepared statement?

STATEMENT OF BRIG. GEN. HOMER A. BOUSHEY, DIRECTOR OF ADVANCED TECHNOLOGY, OFFICE OF DEPUTY CHIEF OF STAFF, DEVELOPMENT, U.S. AIR FORCE

General BOUSHEY. Yes, sir.

Members of the committee, Mr. Chairman, and counsel. In the interests of saving time, my statement is prepared so that it can be reproduced. With your permission I would like to use the Viewgraph, but first I would like to go through about 30 seconds of an opening remark to tell you what we are going to do, if I may, informally.

I will stand up by the Viewgraph screen and just tell you the Air Force program, what we have done, what we would like to do, and where we are going in the future during the unclassified session. I have Dr. Roadman, a Chief Flight Surgeon, with me.

Unfortunately, due to the space limitations, our many aerospace medical exhibits which were in the hall could not be displayed in the committee room today, but since I think the Air Force capability is unique, and we are proud of it, your committee, sir, might be interested in a few facts about our aerospace medical capabilities.

The CHAIRMAN. This is the Space Committee. We are having trouble with space and that is not unusual.

Mr. MCDONOUGH. For the benefit of the committee members and the record, would you identify yourself and your assignment, General.

General BOUSHEY. Yes, I am Brig. Gen. Homer A. Boushey, sir, I am on the Air Force staff at headquarters, I am responsible for the Directorate of Advance Technology. This name was chosen to correspond with Mr. Roy Johnson's Advanced Research Project Agency of the Department of Defense. In plain English, my responsibilities are mostly allied to space development matters for the Air Staff.

The CHAIRMAN. Proceed, General.

General BOUSHEY. Yes, sir.

In the limited time available it will be my objective to emphasize quickly, what the Air Force has done to develop a military aerospace capability; to outline what the Air Force is doing in this field, and to present what capabilities the Air Force believes must be developed in the future.

To start with, I would like to define two general areas: the scientific challenge of space and the military requirements in space.

These areas are neither separable nor competing. The former, the necessity to meet the scientific challenge of space and to more than match Soviet scientific capability, is unquestioned.

Likewise, the latter, the need to develop a preeminent U.S. military aerospace capability, is, I believe, no longer subject to debate.

Such a military space capability can greatly improve our security; its lack might prove disastrous.

I shall confine my brief remarks solely to the military aspects.

Also, I believe it will be helpful to briefly review the Air Force role, the areas in which we operate, and the means by which we fulfill our mission responsibilities.

These can be stated very simply.

The Air Force's historic role has been that of continental defense and strategic deterrence. We operate above the land and sea areas

of the world. The techniques by which our missions can be performed—be they by manned aircraft or by unmanned missiles—has always called for greater speed, greater range, and greater altitude.

Even before Sputnik I, Air Force techniques had advanced well into that region above the earth which is now called outer space. In the past there was no sonic barrier. There is, I believe, no space barrier now.

Our missions remain the same, and our traditional sphere of operations extends above the surface of the globe as far as it may prove militarily necessary to so operate.

I would like now to go to the viewgraph screen and point out very quickly some slides which I think you will find interesting, and make a few remarks pertinent to them.

Slide No. 1 illustrates the point I was trying to make regarding "higher, faster, farther." You may recognize some famous names, Doolittle, Yeager, Schroeder, and the original Explorer, the manned balloon flights made in connection with the National Geographic Society.

The chart on the left shows increasing speeds throughout the years.

The chart on the right shows increasing altitudes; again with reference to time, notice the position of the ICBM and IRBM, located only generally so as to avoid classification.

Notice the positions of satellite velocity, escape velocity, and orbital altitudes. You will notice the trends, even before sputnik, which were reaching both satellite speeds and altitudes. We believe this is nothing new to the Air Force. Could I have the next slide, please?

This is a view of our latest research aircraft, the X–15. I am sure you are aware of this vehicle.

It is shown here under the mother ship, a B–52.

Next slide, please.

This aircraft was unveiled to the public in October.

This next view shows it climbing after the drop from about 38,000 feet, and going up to the altitudes of which it is capable—in the order of 100 miles or better.

Next slide, please.

The typical flight profile of the X–15 shows a range of about 450 miles. This typical chart shows the starting location, Wendover, Utah, and the X–15 climbing to an altitude above 99.9 percent of the atmosphere. This represents operations in the near vacuum, or you might say, space conditions. The slide shows the reentry heating during descent, and final landing at Edwards Air Force Base.

May I have the next slide, please?

This shows the heating during the reentry period. The X–15 will be capable of a flight speed of about mach 6, and we expect that it will first have captive flight sometime this month and shortly thereafter, an unpowered free drop.

May I have the next slide, please?

This last view shows the landing of the X–15 on its skid on the dry lakebed at Edwards Air Force Base, Calif.

The X–15 is an outgrowth of the very famous X–1 and X–2 versions in which Captain Yeager first broke the so-called sonic barrier.

May I have the next slide, please?

Following the X–15 will come what we call the Dyna Soar vehicle. It also is for research and investigation of high-speed, high-altitude flight. It will also give us the space- and weight-carrying capabilities to test navigational, photographic, and other systems in the conditions of high speed, high temperature and high altitude.

The area between these two lines [indicating] is what we call the reentry corridor. For safety, it is also the route which should be followed to "escape" the sensible atmosphere and ultimately attain satellite speeds and altitudes.

Vertically, on the left, we have altitude in thousands of feet and speed in thousands of feet per second on the horizontal.

The small green area shown in the very limits of the lower left is where conventional aircraft operate at this time. You can see the tremendous increase in potential.

The X–15 performance is shown only generally, because when we mark altitude and speed together, this becomes classified information.

The Dyna Soar will have the capability of exploring this entire regime, the so-called corridor of escape. A word of explanation might be beneficial here.

Above the upper line, the vehicle would be flying too high and too slow to maintain lift aerodynamically.

Below the bottom line, the vehicle would be flying too low and too fast. The air is so dense we would soon reach a temperature condition which we would not be able to operate in.

Again, the purpose of the Dyna Soar vehicle is to fully explore this corridor, making it as wide as we can, and eventually reaching near satellite speed and altitudes.

The Dyna Soar name is a peculiar one. It is not the prehistoric monster. It stands for dynamic soaring. As we reach the speeds of near-satellite velocity, centrifugal force is the main sustaining power. The "soar" part represents the aerodynamic lift of the final stage, which is an unpowered glider, and which can glide perhaps to global range in the anticipated future.

If you have any questions, I would be glad to answer them now or whenever you wish.

Mr. McDonough. How is that top line established, the escape corridor?

General Boushey. This is a representative pair of lines only, sir. The studies go back to the former NACA studies and the Air Force has also spent perhaps 5 to 7 years of study to look into the feasibility of manned flight through the corridor and the regime up to satellite velocity.

The top line is established this way. Above it, either the air is so thin that the aerodynamic lift of wings cannot sustain the weight of the vehicle, or the vehicle has climbed too high on rocket thrust. For example, by rocket thrust, an aircraft might climb far above the altitude at which it could sustain flight by aerodynamic lift alone. When the rocket thrust ended, then gravity would accelerate the vehicle earthward, and by the time it reached a lower altitude where the air was dense enough to provide significant aerodynamic lift, why then the aircraft would be traveling at such a high speed that the temperature caused by air friction and the generation of shock waves would heat the vehicle beyond controllable limits. Below this lower

line, the combination of density and speed are such as to cause unbearable heating which the vehicle is not designed to stand.

Within this corridor we have enough aerodynamic lift to fly, and we expect to control the generated heat.

Mr. McDonough. Has that been determined through wind-tunnel experiments?

General Boushey. Extensive and numerous hours by both the NACA and private contractors under contract to the Air Force, and also with their own company-sponsored money, sir.

The Chairman. I don't quite follow what you mean by escape corridor. Would you explain that again, General Boushey?

General Boushey. Going from sea level and subsonic flight, following a flight path in speed and altitude that will allow a manned vehicle to finally arrive at satellite altitudes and speeds without detriment to the vehicle or the man.

The Chairman. Why do you say "escape corridor"? Is that the pattern he would have to follow in the event he wishes to bail out?

General Boushey. No, sir; "escape" in this sense means escaping from the dense atmosphere rather than any connotation of escape for the safety of the pilot. Probably a better term is reentry corridor, but since the pilot would wish to follow the same general route on climbing out of the sensible atmosphere to near-satellite velocities and altiudes, in that sense I called it the escape route.

The Chairman. Proceed.

General Boushey. Next slide, please.

Turning now to the sentry system, called weapon system 117–L, this is a graphic portrayal showing when the Air Force interest first started, in 1946, with a contract to the Rand Corp. I believe your committee is familiar, sir, with the Rand Corp. They were helpful in preparing your very excellent space handbook.

These studies were conducted initially with approximately $1½ million. They showed that a military satellite was feasible and possible, and that it would have possibly very pronounced military advantages.

Up to the end of 1953 or early 1954, $7.4 million was expended. In 1956 weapon system 117–L was actually started, and the Lockheed Aircraft Corp. was selected as the contractor.

This small figure at the lower left is merely a rough artist's conception of what the original type of satellite looked like. It is not classified, merely an artist's concept.

The point I want to make is that the Air Force started to study the possibility of military satellites as early as 1946, and actively began the actual work long before sputnik was a fact.

Could I have the next slide, please?

Mr. McCormack was the chairman of the select committee at the time. I, among others, had the privilege of making predictions as to what I thought was the future of space.

I believe that propulsion is the key to further scientific exploration or military purposes in space. So let me discuss liquid-rocket developments in the Air Force.

This, you might say, is the family tree of the Air Force rocket-engine development, beginning back in 1942, with the assisted take-off devices, the liquid-rocket engines of the X–1, X–2, and the various

engines that are shown here, arriving at the very top at the million-and-a-half-pound thrust, single-chamber development which has already been mentioned to your committee.

I mention these to show the time period and the span in which the Air Force has been developing liquid-rocket engines.

These are all liquid-rocket engines.

The Navaho weapon system, you may know, was canceled 2 years ago. Fortunately, an outgrowth of that program, which was an air-breathing, ram-jet powered, intercontinental and hypersonic missile, was the development of the engines which later powered the Thor, Jupiter, and then the Atlas.

Also, the guidance system developed for Navaho enabled the Navy, with its nuclear-powered submarine, to navigate the Arctic Sea, and under the North Pole.

You will notice the Titan powerplant, which General Schriever already spoke about. It uses a liquid-rocket engine developed by the Aerojet Corp. There was also an early 300,000- to 400,000-pound thrust, single-chamber development. It has since been terminated.

Take the overlay off, please.

This shows the development of the high-energy, upper-stages engines which are useful in carrying the final payload into satellite orbits or for space exploratory purposes.

During 1958 practically all of the Air Force liquid-rocket engine developments were transferred to ARPA, or subsequently to NASA.

Could I have the last overlay, please?

This shows the Rover project, the nuclear power rocket engine, which was started by the Air Force, in conjunction with the Atomic Energy Commission.

This, again, has been transferred to the cognizance of the NASA, who are continuing the work with the AEC.

The last overlay, please.

This shows one high-energy upper stage under the management, direction, and control of ARPA, and this rocket engine development will be transferred to the cognizance of the NASA in July of this year.

The only remaining Air Force liquid-rocket-engine development—true development—is for improvements to the small Hustler engine.

That summarizes the liquid-rocket engine development program, sir.

We have developed, over the years, a terrific investment in not only the static test stands but also the laboratories at Wright Air Development Center, and the Arnold Engineering Center, where not only air-breating engines are developed but also rocket engines are fired at reduced atmospheric pressures. Nose cone reentry tests were also made at Arnold Engineering Center at full scale or close to full size in their very high velocity wind tunnels.

Could I have the next slide, please?

This is an aerial view of Wright Air Development Center, and the parts outlined in black show the very extensive power plant laboratory complex at Wright Air Development Field.

Next slide, please.

This is a typical view of a rocket-test stand at Edwards Air Force Base. I am sure you are familiar with these types. They are exam-

ples mentioned to show the investment that the Air Force has in powerplant facilities.

To summarize: It is estimated that our laboratories and facilities in the Air Force are worth close to a half-billion dollars for the purpose of rocket engine development and tests. Other facilities, such as the Arnold Engineering Development Center, are also useful for wind-tunnel tests as well as pure engine development.

The next slide, please.

This, again, is another view of a rocket static test stand, typical of the facility that can handle the million- and million-and-a half-pound thrust unit.

Next slide, please.

Again, a firing view.

The next slide, please.

This shows one of the rockets during the takeoff after the countdown, which was discussed this morning.

May I have the next slide, please?

One thing which the Air Force has found over the years, as our technology improves, our capability also improves, but usually the technical complexity also increases, as this curve graphically illustrates.

These are calendar years at the bottom [indicating], and in this particular chart, engineering man-hours for the design and development are shown vertically on the left. For example a comparison is made 200,000 engineering man-hours for the B–17, (the familiar Flying Fortress of World War 2) as compared to the B–58, requiring 9,340,000 man-hours for engineering development alone.

Could I have the next slide, please?

That former chart was shown merely for the purpose of showing why the weapons system concept is considered by the Air Force to be a necessity. It is a management concept which provides for planning, scheduling, and controlling, from design through its life as an operating entity, the complete weapons system, the air vehicle, its components, supporting equipment, and the preparation for its operational use.

May I have the next chart, please?

Now, here are about a dozen factors which must be considered during the optimization of any weapons system. If the arrows are optimized, or you might say extended to the right, this may adversely affect some other factor. Performance might affect reliability. Some factors are [indicating]: producibility, procurability, maintainability, and economy (which General Schriever mentioned, is a happy circumstance for the Minuteman ballistic missile) transportability, and operability—you could add some more "abilities" if you wish. This is a baker's dozen. You could add to the list or perhaps take away. For instance trainability is most important, and it isn't even listed.

The purpose of showing these three slides was to introduce you to the Air Force weapons system concept, which I believe has since been adopted by both the Army and Navy. The Navy effectively manages their entire Polaris program under the weapons system concept.

If there are no further questions, sir, at this time I would like to introduce Colonel Roadman, who happens to be an Air Force com-

mand pilot and also a chief flight surgeon. He is particularly well qualified to give the committee, with your pleasure, a brief review of some of the aerospace medical capabilities of the Air Force.

The CHAIRMAN. We would be happy to have him.

Mr. MCCORMACK. Might I ask a question?

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. Several years ago, Mr. Riehlman, chairman of the Committee on Government Operations, conducted extensive hearings as to military and science as a team.

Do you remember that?

General BOUSHEY. I certainly do.

Mr. MCCORMACK. I sat in on that.

To pinpoint for the record, would you state what the relationship is now as a team?

General BOUSHEY. Over the years we have learned there must be extremely close coordination between scientists, technologists, between all categories and abilities, and the point that I think is important is that this coordination must be effected with the future operator, right from the beginning of the design and development stage.

Is that the point you were trying to get, sir?

Mr. MCCORMACK. It wasn't an investigation. It was an extended hearing. There were conflicts that existed, men taking different journeys through life and reconciling them.

I assume you studied the evidence of those hearings.

General BOUSHEY. Yes, sir.

Mr. MCCORMACK. And the report of the committee?

General BOUSHEY. Yes.

Mr. MCCORMACK. As you were testifying, I was curious, and my thoughts went back to those hearings as to the close relationship that has been developed subsequent to the hearings.

General BOUSHEY. Yes, I think we have tried energetically to develop that, and the Air Force, as I am sure Mr. Riehlman is aware, has a Scientific Advisory Board and a Chief Scientist, whose sole purpose is to help us effect this close tie and coordination with the scientific fraternity.

Mr. MCCORMACK. Those hearings were not for the purpose of trying to expose anything, but to ascertain the facts in relation to human relationship.

We appreciate the fact that in the military the life of one has got to be strict. Discipline and obedience are very prominent words and must be in practical operation, and when you get into your scientists you get a very individualistic-minded individual and group.

But in developing the spirit of teamwork, having in mind the best interests of our country, and the national interests of our country, that was the purpose of it, not so much to expose or to be critics, because we are all human beings ourselves, and we have our little conflicts here in Congress that we have to reconcile at times. It was more to probe areas of agreement than to create areas of tension and disagreement.

Without going into it fully, I value your opinion very much. Do you think that the team spirit is much stronger today than it was then?

General BOUSHEY. Yes, sir; I believe it is.

The CHAIRMAN. Now, General, will you proceed with the next witness?

General BOUSHEY. May I introduce Colonel Roadman, Chief of the Human Factors Division, Directorate of Research and Development, Headquarters, USAF.

The CHAIRMAN. Will you have a seat, sir?

STATEMENT OF COL. CHARLES H. ROADMAN, CHIEF OF HUMAN FACTORS DIVISION, DIRECTORATE OF RESEARCH AND DEVELOPMENT, HEADQUARTERS, U.S. AIR FORCE

Colonel ROADMAN. I am Charles H. Roadman.

The CHAIRMAN. Do you have a prepared statement?

Colonel ROADMAN. I have a prepared speech, sir.

The CHAIRMAN. This morning the commitee asked that, if possible, copies of the prepared statements be made available to members of the committee to do a little night work on, if they wished to. If it isn't too much, we would ask you afterwards, later on, in the next few days, to give us copies of your prepared speech.

Colonel ROADMAN. I shall be most happy, sir.

In the space age and the problems we are faced with, I am sure we all recognize that we do have a problem of semantics. What I am going to talk about this afternoon can be called our Air Force aerospace medical effort. It can be called our human factors research and development program within the Air Force, but for the purposes of description this afternoon I am going to refer to this area as our life sciences program. I use the term "life sciences" because at the present time the definition of our program is in the area of life sciences.

This is aviation medicine, psychological work, human engineering and the like.

The Air Force life sciences research and development program is conducted as an integral part of the weapons system concept which General Boushey has outlined to you. Its program is directed specifically to weapons system support.

Now, as in the past, our attention is focused on man and his relationship and contribution to the Air Force mission.

May I have the first chart, please?

Our development program is directed, as you can see, toward two broad problem areas. These are, in the simplest terms, concentrating on the performance and protection of man.

If you will think with me as we go through this briefly, I think it will become more clear to you.

It should be readily apparent to you that our efforts are applicable in the assessment of man-machine interpretation, whether it be one operating within the atmosphere or within space. To us, and physiologically speaking, there is no clear delineation or demarcation between aviation medicine and space medicine, for example.

The Air Force life science program and capability is known by many of you here today.

May I have the second chart, please?

Of necessity, it is important to approach human factors, research and development with multidisciplinary scientific talent. The team effort among specialists has contributed much toward our scientific

success. The magnitude of our present life sciences effort reflects a continued recognition of the important contribution made in support of our growing complex and complicated system development.

In manned systems there must be integrated programs which focus not only on hardware but insure man's capability to perform useful tasks, here again in the items in General Boushey's baker's dozen, reliability, performance, maintainability are in a practical sense concerned with our area of interest.

As a national asset the Air Force has the largest life-science program and capability in the country, both in numbers of people and facilities. These are directly alined to support our aerospace mission.

The listing of some of our better known facilities can be associated with outstanding scientists, both civilian and military. The names of Col. John Paul Stapp, Lt. Col. David Simons, Dr. Strughold, who fortunately is with us this afternoon, and our first full professor of space medicine is with us this afternoon, and the name of Flickinger, as an example, who is also with us this afternoon, are recognized as authorities in their respective fields of endeavor.

May I have the third chart, please?

All too often in the past, systems development has progressed without orderly consideration of man's functions and man's capabilities. In order to assure man-machine capability, these steps must be followed. In short, one should not develop a system and then arbitrarily put man into it. This has been a problem in the past. It is still something of a problem, but this is the design goal for which we are striving.

This orderly and integrated development process is the basic principle of the Air Force weapons system concept.

May I have the fourth chart, please?

This, to me, gentlemen, is the most important chart. I want to elaborate on some of the more important points.

Basically, man was not designed to fly. Because man has ventured beyond the terrestrial environment, we are confronted with human limitations to atmosphere and space variances. These are really physiological barriers which must be overcome and which give rise to our life science programs.

On the left of the chart I have listed a few of these limitation areas. It is impossible for me in the time permitted to go into a full scale of all of our programs. I would like to point out or let us consider one area.

As an example, let us follow through our past, present, and future research and development growth cycle.

At this point keep in mind the basic developmental growth of the Air Force, which has consistently concentrated on greater speed, greater range and altitude.

This, in effect, is the airman's domain. These three factors from a biomedical point of view have provided a functional delineation for past, present, and future aeromedical life sciences effort.

As we progress higher, the need for human protection becomes more sophisticated. Thus we see the growth of oxygen systems progessing from the simple rubber tube that a pilot sucked on in the past, to the development of sealed cabins and closed-cycle, regenerative oxygen systems which will undoubtedly be needed to protect man in space ventures.

Since man cannot exist without his earthly atmosphere, he must take it with him or find a way of recreating it.

I believe there is another very important conclusion to be drawn from this chart. Today the Air Force is operating in a physiological space equivalent area. Two notable exceptions of this, of course, are well known to you, the problems of weightlessness and the problem of the radiation hazard. By this I mean, in terms of space equivalent, I mean the atmosphere at flight levels is insufficient to support life, and in the case of oxygen above 75,000 feet, the atmospheric air cannot be drawn upon to provide oxygen or cabin pressure. Conditions are identical insofar as oxygen is concerned to flight in free interplanetary space. In other words, we are operating now in some of our areas—take the X–15, for example, in physiological space equivalent areas, at altitudes as low as 50,000 feet, man must be contained in a pressure suit or pressure cabin, because atmospheric pressure is insufficient to force oxygen into the bloodstream.

I call your attention to the exhibit we had in the hall, what we call our MC–2 or X–15 pressure suit, which will be worn by Scotty Crossfield in his flights. This is a pressure suit, a pressure garment.

In the future, all supplies to replace atmospheric ground must be brought from the ground, even though the vehicle does not leave the atmosphere. Physiologically speaking, flight conditions will be the same as for space flight. Only the complexity and endurance of equipment must be changed for flight anywhere in space.

Other factors in the field of protection of fliers follow a similar course and reach a point within the atmosphere where the requirements for protectton are equivalent to flight in space.

Our life sciences research and development in the Air Force has addressed its effort to protecting fliers from the hazards associated with flight at ever-increasing speeds and altitudes. For certain areas we have already attained the degree of protection required for space flight. Other problems of space-flight protection are only logical extensions of our present program and are directly alined with the facilities and capabilities laboriously acquired by the Air Force in the past.

Other conclusions to be drawn, though less obvious, are these:

The Air Force life sciences effort has kept pace with the ever-increasing speed, range, and altitude capabilities;

Two, Air Force scientific personnel and facilities, who have in the past ensured proper performance and provided protection for fliers, will continue to serve the same functions, whether flight be within the atmosphere or in space.

This concludes my brief talk in terms of our life sciences effort, Mr. Chairman.

I am sorry that we had to remove our exhibit. We were limited in terms of space.

I would like to just make this comment:

Although some of the animals do cause concern with certain groups of people, we recognize this. However, we have had and continue to have a very vigorous aeromedical aerospace program. You all know in this room we do require animals in terms of experimentation. I think for those of you who saw our exhibit, I think this will give you at least a thumbnail observation of the types of work in terms of per-

formance and protection that we are so vitally interested in as we progress toward the space age.

The CHAIRMAN. Thank you very much, Doctor.

We appreciate your statement.

Are you operating out of San Antonio?

Colonel ROADMAN. No, sir; I am here in Washington, in headquarters, USAF.

The CHAIRMAN. Any questions?

Mr. RIEHLMAN. Mr. Chairman, I would like to request that the charts that have been shown may be made a part of the record for clarification, because I think they are important.

The CHAIRMAN. Do you have copies that could be made available for the record?

Colonel ROADMAN. Yes, sir.

(The requested charts follow:)

LIFE SCIENCES

Biological and medical sciences directed toward the problems of—

A. Analyzing the knowledge and skill requirements of a given task and devising methods of selection, training, and man-machine job engineering which will yield a reliable human operator.

B. Analyzing human limitations to environmental variances and providing protection and maintenance where these limitations are exceeded.

LIFE SCIENCE RESOURCES IN THE AIR FORCE

A. Personnel:
   1. Specialties:
      A. Medical.
      B. Biological.
      C. Psychological.
   2. Numbers: 1959—1,225

B. Facilities:
   1. Aeromedical laboratory
   2. Air Force School of Aviation Medicine
   3. Aeromedical field laboratory
   4. Air proving grounds center
   5. Flight test center

A. HUMAN KNOWLEDGE AND SKILL REQUIREMENTS

1. To determine performance required by mission.
2. Develop crew station design criteria.
3. Determine qualifications of operators.
4. Develop training techniques and training devices.
5. Maintain effectiveness of operators.

LIFE SCIENCES DEVELOPMENT EFFORT

B. HUMAN LIMITATIONS TO ENVIRONMENTAL VARIANCES

Limitations areas	Past (diminishing atmospheric dependence)	Present (biological space equivalence)	Future (terrestrial independence)
Oxygen	Oxygen masks	Pressure breathing recycling system. Liquid oxygen	Oxygen regeneration. Solid oxygen. Conversion of wastes.
Pressure	Partial pressure suits	Integrated pressure suit and capsule.	Sealed cabin.
Temperature	Insulation from cold	Aerodynamic heating	Climate control in sealed cabin.
Atmospheric filter	Sunlight Ultraviolet	Solar radiation Cosmic rays	Solar heating. Cosmic radiation. Darkness of space.
Escape and survival	Parachute Land and sea survival kits	Ejection seat Global survival kits	Sealed capsules. Recovery vehicles.

The CHAIRMAN. Are there any further questions?

If not, we thank you very much for a very fine statement.

Now, let's see, do we have any other witnesses that can be heard in open session?

General ANDERSON. Mr. Chairman, I think that concludes what we are prepared to give in open session.

The CHAIRMAN. Fine.

If there is no objection, then the committee will go into executive session.

(Whereupon, at 3:48 p.m., the committee proceeded in executive session.)

EXECUTIVE SESSION

The committee resumed in executive session in room 219, Old House Office Building, the Honorable Overton Brooks (chairman) presiding.

The CHAIRMAN. General Schriever conveyed to me he had an engagement with the Secretary of the Air Force that we would delay if we were going to use him this afternoon. If that is the case, if we could use General Schriever and finish with him, perhaps he could make that engagement. I leave that up to you as to the order in which you want to call them.

General ANDERSON. General Schriever informs me that has been postponed until tomorrow morning so he can be available to your committee.

The CHAIRMAN. Fine.

General ANDERSON. General White asked me to open with a short statement if the committee would care to hear it.

The CHAIRMAN. Have a seat, General. We will then turn the meeting over to you, and you call the witnesses as you want them to be heard. We will permit the reporter to take down the notes unless you ask that some of the statements be not even recorded. Of course, everybody in here has been cleared for security purposes and the committee knows the intonation behind the meaning of executive session, so they will be careful about what they say.

STATEMENT OF LT. GEN. SAMUEL E. ANDERSON, COMMANDER, AIR RESEARCH AND DEVELOPMENT COMMAND, U.S. AIR FORCE

General ANDERSON. Mr. Chairman, gentlemen of the committee, this morning we discussed in unclassified terms the Air Force research and development program. We gave you a picture of ARDC, its experience, its capabilities, and its work in fields that will contribute to the furtherance of national projects. As the President has stated and as General White has further emphasized this morning, our objective is to utilize the new knowledge obtained from space science and technology for the benefit of all mankind. However, as General White also stated in these critical days, the practical use of space knowledge must be considered primarily from the standpoint of their application toward the security of this Nation and of the free world. This must exist until such time as the use of space for peaceful purposes is assured.

Therefore, this afternoon we shall discuss on a classified basis our military and astronautics capabilities. Consider briefly, if you will, the essential requirements for a successful military astronautics pro-

gram, regardless of whether the military or other agencies are responsible for the development of this capability.

The first and perhaps most obvious requirement is for a large rocket engine program. Next comes the requirement for the vehicle itself, matched compatibly with rocket engines, payload, and associated equipment, and constructed with due consideration for high stress and temperature conditions. Essential to the vehicle is the provision of a guidance system for accurate positioning and navigation during all phases of flight and last but most important, if the vehicle is to be manned, is the requirement for a strong bioastronautics program. The purpose of such a program is to give us the information needed and develop the techniques required both to maintain man's life in space and to permit him to perform effectively in this environment.

Although somewhat oversimplified, this summary gives the essential ingredients for a military astronautics program. How are we, the United States, to equip ourselves to meet these needs?

Since World War II, the Air Force has been pushing the development of large rocket engines. This program which had its start with the Navaho development has brought forth the liquid rockets used by all major missiles, Army as well as Air Force. It has produced the engines for the Army Redstone and Jupiter and the Air Force Thor, Atlas, and Titan. * * * we have done much work leading to a single chamber rocket of much higher thrust as has been mentioned here today.

Recently, as I said this morning, NASA took over this program. The Air Force retains, however, considerable engine development potential which can be used alone or in cooperation with other agencies. Nose cone reentry work performed by the Ballistic Missile Division and other research done by and with the highly experienced Materiels Laboratory at Wright Air Development Center have given us an excellent background for designing and constructing space vehicles. ARDC has been working intensely in the area of missile guidance for over 12 years. The Navajo and Snark programs paid off here as did our work with Dr. Draper at MIT on guidance developments for other purposes. The guidance system developed for the Atlas ballistic missile is today more than adequate for any astronautics program.

Additional guidance development, however, is underway at our ARDC centers. In the field of bioastronautics the Air Force, in working with manned balloons, rocket sleds, and high altitude vacuum chambers, has developed a unique capability for the solution of the biomedical problems of space. The School of Aviation Medicine, the Aeromedical Laboratory at Wright Field and the Aero Medical Field Laboratory at the missile development center have made significant contributions in this area and are well equipped to continue their work toward the solution of the physiological and psychological problems of space flight.

Since the Wright brothers delivered the first military airplane about 50 years ago, we have been directing our efforts toward flying higher and faster and staying up longer. The most advanced weapons system study that we have underway for strategic air operations is the Dyna-Soar described by General Boushey. Here our concept is one of putting man in a vehicle which is boosted to speed and altitude by several stages of rockets. * * *

Obviously such a development as this will be more than militarily useful. It will serve in its various stages of development as a research vehicle for more advanced space flight programs. We are coordinating this particular program very closely with NASA since it should serve many research requirements of that agency.

I would like now if there are no questions, Mr. Chairman, to turn to a classified discussion of our missile and military astronautics program and ask General Schriever to take the stand.

The CHAIRMAN. Thank you, General.

General Schriever, will you step forward, sir? Now if we reach a point in your statement that you do not wish the statement to be recorded by the reporter, just let us know and we will have it off the record.

General ANDERSON. This particular statement is under preparation for distribution to the committee. I do not think it is so critical that it cannot be recorded if the committee wishes it.

The CHAIRMAN. All right, sir.

STATEMENT OF MAJ. GEN. BERNARD A. SCHRIEVER, COMMANDER, BALLISTIC MISSILE DIVISION, U.S. AIR FORCE

General SCHRIEVER. I would like to discuss the Air Force ballistic missile program. If you do not mind I will stand up because I am going to point at a couple of charts. I would really like to make two major points this afternoon.

The first one is the nature of our management concept; the leadtimes that are involved to get a ballistic missile from the development stage into operational category. I think I can best describe this by showing the leadtimes involved in the management concept we have been employing for the past 4½ years.

The second point I would like to present to the committee is our current force buildup, that is, the schedule of buildup of ballistic missiles both in the IRBM and the ICBM programs. Then if you have any further questions with respect to details—I will not get into the technical details of our ballistic missiles—I will be available and attempt to answer.

THE NECESSITY FOR CONCURRENT DEVELOPMENT ACTIONS

The first chart—and I will get back here where I can point to it—indicates the necessity for an integrated planning, programing, and budgeting effort. Here are the five major areas of the Atlas program, leading to an initial operational capability in June of 1959. Our other programs are being carried on in the same way.

We started our research and development program study well before 1954. There was a great deal of study and small-scale experimental work in the ballistic missile effort, but we actually, in late 1954, completed our technical studies, the system analyses, and froze on general specifications for the Atlas program. Our first big job—and this is always the first big job in all major development programs—was to get the research and development facilities established. They require the first long leadtime.

This line indicates certain major development milestones, such as the first battleship test, and I will explain what a battleship test is.

It is a captive test on a stand, but instead of using the thin-skinned tank structure that is in the flight missile, we use a heavy steel structure from which we can get repetitive testing. It is a complete missile with all of the subsystems, however. This is normally our first major milestone in the complete missile testing. It is followed shortly afterward by captive testing of the complete missile. Then comes the first flight, and then a series of flight tests which prove out the missile as a whole—all of the subsystems, from a performance standpoint. Further flight testing, of course, is very important from an operational standpoint to develop the reliability necessary for operational use.

Actually we did not freeze on certain of our final specifications until late in calendar year 1958. Our first operational prototype, actually our first operational capability with the Atlas, will be in June or July of this year.

Now there are other things that have to be done if you want to compress the timetable between the initiation of development and this date out here [the operational capability date]. Our production facilities, for example, must be created on a concurrent basis. You notice here that this is our production capability to produce * * * missiles a month to support the research and development test program. Here we show a * * * missile per month capability. Actually that is on a single-shift basis. We have a total capacity on the three-shift basis of about * * * per month.

The CHAIRMAN. That is the Atlas, you have a capacity of * * * per month?

General SCHRIEVER. That is right. That is the Atlas, and it is not only the Convair end of Atlas, but all of the subsystems, the North American engines, the General Electric guidance, the Arma guidance, the Burroughs computer, and so forth; in other words, all of the major subsystems.

You notice we actually have to make a commitment for those production facilities. There is a leadtime of about 24 months prior to the time that we actually had our first flight in the Atlas program. This means that from a budgeting standpoint we had to plan and budget for this money out here somewhere [indicating the 1954 area]. So when we came to Congress we were a long way away from this first flight, but were asking for production facilities when you just had to take our word that we were going to do what we said we were going to do. This material indicates the long leadtimes and the kind of planning and programing that is involved in the base construction area. In ballistic missile deployment we have had to establish a completely new operational environment. We do not go on to an existing airbase. We have had to develop operational concepts, and all of the things that go with them in establishing operational environment.

As for construction leadtime, starting with the point of site selection, and developing the design criteria, then the actual design involved on a specific site—like Vandenberg or Warren Air Force Base—this is about a 6- to 7-month period prior to commencing construction.

We have in addition to that an installation and checkout period where we install all of the ground support equipment. This takes about another 9 months. Some of this is overlapping. About 3 months of this is overlapping with the construction.

To get to the point where you have a facility that is actually useful, it takes a leadtime of 40 months. I show 40 months here, including training, and we have compressed that a little, but we are still talking in terms of 30 to 33 months from here to here [indicating start to finish]. Then you have the training of your first crews in the operation of units on an operational facility, another 3 to 4 months.

So you see again there is a tremendously long leadtime during which you must perform the programing and budgeting. To set up the initial training program requires a leadtime of about 33 months. Once we get the training facilities established, then, of course, we are in a much shorter time period for training. We are in a training period of, say, 12 to 15 months of individual training, crew training, and unit training.

In the support area we have the same problem, establishing what we need in the way of spare parts, making out unit allowance lists, and the whole gamut of things that are required to support the operation, again a long leadtime.

THE CALCULATED RISK

The main point I want to make here is that the only way in which we can compress the time period between the initiation of development of a major weapons system until you have it operational is to do all these things concurrently. This is what we have been doing in the ballistic missile program. There is a certain amount of calculated risk involved, but it only is a risk really if you should fall flat on your face and find that you have got a basically unsound weapon.

If you find that you have a fundamentally sound weapon, you actually save money by this technique because you do not stretch out the program so long. With time as important as it is in our day and age of thermonuclear weapons and ballistic missiles, I see no other choice but to do our jobs in this manner.

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. General, this is a good deal similar to the thing that you had to go through with in the development of new planes when there was a major change from piston type to a jetplane, it it not?

General SCHRIEVER. We have not always done it this way. We have too often built just a few experimental prototypes, then proven out the system, and then built up the production base.

In other words, we have done things in series rather than compressing and doing things concurrently.

Mr. MILLER. In the case of the B–47 did you not do it like this?

General SCHRIEVER. No, sir, not in the case of the B–47. That was a bad example.

Mr. MILLER. How about the B–52?

General SCHRIEVER. The B–52 was closer, but you must remember also in the case of aircraft we already had in existence a certain operational environment.

Mr. MILLER. The point I am making is even when you have all of the experience with the aircraft, when you made a major change and brought into the inventory a new craft, you still had to have long leadtime and still had to take a certain amount of calculated risk.

General SCHRIEVER. Oh, yes; this is exactly right.

Mr. MILLER. And what you are doing here is even shorter in my remembrance than some of the others. We viewed some of this in 1955.

General SCHRIEVER. They called it the Cook Craigie plan. We endeavored to build enough aircraft during the development and test program to have the nucleous of the production base to begin with and as soon as you got to a reasonable point in the program you could accelerate production.

Mr. MILLER. That is right. But to get the prototype took a great deal of time.

Mr. TEAGUE. Mr. Chairman.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Without talking about who, where, when, why, or what, what part has money played in this and what about the future? We have had a lot of starts and stops, but overall what has the appropriations to do with it?

General SCHRIEVER. We have not had stops and starts in the ballistic missile program. We have had a lot of reprograming efforts in the Pentagon, of course, but we have steered a very stable course in terms of the development effort, and we have stuck to this philosophy of what we call concurrency of planning and programing all of the elements. They are all under the control of the management complex out in California, where we have the Research and Development Command, the Air Materiel Command, and the Strategic Air Command, and a large liaison office from the Training Command.

So we are all working together.

Mr. TEAGUE. And generally you have had sufficient money to do as your plans called for.

General SCHRIEVER. That is right; we have had enough money to get the job done.

Mr. MILLER. Do you have enough money to produce those * * * missiles per month?

General SCHRIEVER. Those missiles?

Mr. MILLER. Yes, those missiles.

General SCHRIEVER. As a matter of fact, that chart is somewhat out of date. That has been increased. We are moving up to a production rate of * * * a month of the Atlas.

Mr. TEAGUE. Would you say one word about the arsenal concept on this, General, the concept you are following on this.

General SCHRIEVER. I hate to get into a controversial area.

Mr. TEAGUE. Is there any difference?

General SCHRIEVER. In the arsenal concept normally you do a lot of development work in service—that is, the detailed engineering, fabrication, and testing in service—and then you turn over the results of that to the industry to produce for you.

Mr. TEAGUE. You have no great difference in leadtimes?

General SCHRIEVER. The Thor program has been on this concurrency basis. The Jupiter program has been essentially on the arsenal basis.

The CHAIRMAN. Now let me ask you this, General——

Mr. TEAGUE. You have not answered my question, though, General. Has there been a big difference in the leadtime between the two of them?

General SCHRIEVER. There has been a difference, yes, in the leadtime as it pertains to achieving an operational status. I mean having available all of the ground support equipment, the missiles, the operational part of it, there has been a difference. We have contended——

Mr. TEAGUE. Because the arsenal system was not doing that, they were not developing all of them concurrently.

General SCHRIEVER. Well, in fairness though in this particular case, in fairness to the Army, they were not actually directed to build to a particular operational force until fairly late in the development program whereas we had that objective right from the start.

The CHAIRMAN. Now, General, let me ask you this question: Of course, the starts and stops that you refer to apply only to—I mean your statement does not apply to anything but the ballistic program, the ballistic missile program; is that not right? We did have starts and stops in the intermediate range missile.

General SCHRIEVER. No, sir. Well, we had what you might call a temporary slowdown in the fall of 1957 at which time there was consideration being given to whether we go to Thor or Jupiter or both. Actually we were at that stage of the program where the planning and reprograming activities did not have much effect.

The CHAIRMAN. Well, we did have a stop order on the Jupiter C; did we not?

General SCHRIEVER. Well, the Jupiter C is a completely different animal from the Jupiter. The Jupiter C was a test vehicle which actually used the Redstone——

The CHAIRMAN. That is why I asked whether your statement applied only to ballistic missiles.

General SCHRIEVER. My statement applies only to the ballistic missile aimed toward operation capability.

The CHAIRMAN. Now we have reached the point where we are in production on the Atlas at the rate of at least * * * a month.

Also, beginning this year, we are training crews, as I understand your chart, and have been training them for a couple of months.

Now, are we going to put the Atlas out there on the Pacific coast at Vandenberg?

General SCHRIEVER. That is the first base, but there will only be really a very small part of the operational Atlas force at Vandenberg. It will be only * * *, as a matter of fact.

The CHAIRMAN. What are we going to put at Vandenberg, and when will Vandenberg be ready?

General SCHRIEVER. Well, Vandenberg is ready right now for training on the Thor. It will be ready for training on the Atlas within the next couple of months.

The CHAIRMAN. Well, now, would you call it operational, because I notice in the Senate hearings they referred to Vandenberg not being ready for operations before mid-1959, and there was some dispute about that.

General SCHRIEVER. Well, I think you have to define what you mean by "operational" in this case. It is operational today from the standpoint of Thor training and from the standpoint of launches that relate to the Discoverer program. It is not operational yet as far as the Atlas program is concerned.

The CHAIRMAN. Now, when the Atlas, there at Vandenberg—the range of the Atlas is about * * * miles?

General SCHRIEVER. Yes, sir; it has a range of * * * nautical miles.

The CHAIRMAN. That is not far enough to reach across the Pacific.

General SCHRIEVER. Yes, sir. I don't happen to have a chart.

The CHAIRMAN. By the northern route?

General SCHRIEVER. Well, it will shoot right over the polar regions, and it is more than adequate to reach Moscow.

The CHAIRMAN. May I ask one or two more questions?

It is not proposed to stop at that in the development of the Atlas? Is this the end of your development of the Atlas?

AIR FORCE BALLISTIC MISSILE FORCE BUILDUP

General SCHRIEVER. No, sir; the next chart that I have will indicate what the present program buildup is; in other words, what is planned at the present time and what is programed in the 1959 and 1960 budget for the ICBM operational buildup.

The CHAIRMAN. Is that the chart that you refer to?

General SCHRIEVER. This is the chart; yes, sir [indicating].

I can point out here that actually this is the Atlas buildup, and the present program calls for a buildup to * * * squadrons of Atlases, which means * * * operational Atlas missiles.

The end of that comes—you are looking here at the calendar year—in the spring of * * *, when we complete the present approved program, with the first * * * coming in right at mid-1959.

HARDENING AND DISPERSAL

Now, I might say something else about the Atlas. We started off with the Atlas on a "soft" base; in other words, the missle was exposed. This first * * * will be "soft." As a matter of fact, the first * * * squadrons will be "soft," because we are tied to a radio-inertial guidance system, which requires quite a bit of land on which to place the system. Although we are dispersing after the * * * squadron, the next * * *. The last * * *.

There has been an evolution in the whole business of "hardening" and dispersion in the ballistic missile business. We didn't know very much about "hardening" back in this time period back here in 1956 and 1957.

However, on the Titan program, because it was about a year behind developmentwise, we plan from the start to "harden" the Titan to what we call * * *. Actually that is nominal. We think our design criteria indicate that it will be "hardened" to considerably greater—that it will withstand greater overpressures than * * *.

The CHAIRMAN. What do you mean by "hardening?" Is that the base you place them on?

General SCHRIEVER. That means that everything, the men and the equipment and the missile, will be underground and will withstand a nuclear attack up to * * *. And I would say between * * * which essentially says that * * *.

Now, the * * * them in the same way.

This means that an enemy either has to fire a * * *.

The CHAIRMAN. What about that Minuteman?

General SCHRIEVER. We spent a year and a half of study on the Minuteman. We had a very good research program for improving the state of the art in solid propellants prior to that. Improvements in the state of the art of solid propellants, plus the fact that we learned a great deal about the nose cones so that we could * * * plus the very good progress that was made in guidance system, particularly in bringing the size and weight of guidance systems down, these all stem from our ballistic missile program. We have been able to initiate development of the Minuteman system for which the general specifications were firmed up in the fall of 1957.

This particular missile will weigh in the order of * * *. It will be a three-stage solid propellent missile and will have a range of * * * at the minimum, and will deliver a * * * warhead which will have a yield between * * *; in other words, right in the * * * region.

Mr. MCDONOUGH. What is the weight of the Minuteman as compared with the weight of the Atlas?

General SCHRIEVER. The Atlas weighs approximately 260,000 pounds, with fuel and liquid oxygen on board.

I might point out that empty it weighs about * * * pounds, so you can see that it is mostly liquid.

The Titan is about 250,000 pounds, again mostly fuel.

The CHAIRMAN. It would be about * * * times the weight of the Minuteman?

General SCHRIEVER. That is right, gross weight with fuel.

Mr. OSMERS. Mr. Chairman.

General Schriever, does the Titan also use liquid fuel?

General SCHRIEVER. Yes, both use liquid fuel.

Mr. OSMERS. Now, I was interested in the chart that you had up just prior to this one in connection with leadtime, which showed a leadtime of 3½ years for the development of the Atlas up to an operational situation.

Now, if that is so, that same leadtime would not apply to the Minuteman, I gather?

General SCHRIEVER. Yes, sir; it does apply to the Minuteman. The Minuteman is such a completely different system that our operational deployment scheme here is quite different from these other missiles. We actually have two deployment plans. One calls for a single missile in a hole, hardened, dispersed at about * * * distance between missiles, tied into one control center, so that one control center might control as many as * * * missiles.

The missiles, themselves, will be unattended.

Mr. OSMERS. This is the Minuteman concept?

General SCHRIEVER. Yes, sir.

Mr. OSMERS. Go ahead.

General SCHRIEVER. Also, the second deployment scheme, and I am sure we will have a mixture of the two, provides that a certain fraction of the force will be mobile, and there are several different ways in which we can make them mobile. We have looked at * * * looks like the best at the moment, but this is a type of missile that very definitely lends itself to this type of deployment.

Mr. OSMERS. Well, now, if I read your chart correctly, it would be * * * before a Minuteman was operational?

General SCHRIEVER. No, sir; we begin in operation—actually, we feel out here we will have the beginnings of a missile that will have operational characteristics and it might well be this line which shows here [indicating] might be moved back just a little bit in this direction. We could perhaps start the buildup sooner. We call this the operational development phase simply because we are introducing such a completely different operational concept that we think we need about * * * time actually developing in the field, marrying the crews to the missiles, and the ground support equipment, and so forth. So we show a buildup and operational force here in * * * although we expect to have a missile that will demonstrate operational capability in late * * *.

Mr. OSMERS. Is fuel the most difficult problem confronting you in connection with the Minuteman?

General SCHRIEVER. I want to answer that this way: Right now it appears to us that as far as getting the performance characteristics out of the solid propellant, that this will present us with no serious problem, but the * * *.

Mr. OSMERS. * * *.

General SCHRIEVER. Yes, sir.

The CHAIRMAN. General, we are planning some hearings on propellants in the future, but in the meantime in your judgment are we moving toward solid propellants and away from liquid fuels or not?

General SCHRIEVER. I don't believe that you should conclude that entirely. From an operational standpoint—that is from a military operational standpoint—because of the simplicity both from an operational and a maintenance standpoint, and because historically the solids have been more reliable, I think that we will move largely into the solid propellant area in missiles, starting in the 1963–64 time period.

This doesn't mean we won't keep certain liquids in our force, because we will have the operational environment of our liquid missiles. We have bought that. The actual replenishing of missiles over the years is not a very costly thing. The missile doesn't cost so much. It is putting it in the field that costs a lot. The liquid-propelled missile, that is the Atlas-Titan type, for the foreseeable future at any rate, will have a much larger weight-carrying capacity than the solid propellant, so I think that we will have a certain percentage of our missile force in the liquids * * *.

I don't know just what that percentage will finally work out to be, but I think it will be a significant percentage.

Now, in the field of space development, there is no question but that liquids will play a predominant part, at least in the foreseeable future, because of the much larger thrusts that are available there. Although we are using the solids now in second and third stages, the big boosters, the ones that lift the thing off in the first case, I think will be liquid engines for some time to come.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Will you tell me, General, what the destructive capability of the Atlas is, say if it hit Moscow, for example, how much damage would it do?

General SCHRIEVER. Well, I would have to get the atomic effects information, which I just don't have at my fingerprints, but the

first Atlas missiles will have a yield of about * * * and starting, as I pointed out, in about early 1961, we will introduce the * * * which will have a yield of about * * *.

Mr. OSMERS. Mr. Chairman.

How does that compare generally with what fell on Nagasaki?

The CHAIRMAN. Are you through, Mr. Anfuso?

Mr. ANFUSO. I am not through.

Mr. OSMERS. Will the gentleman yield?

The CHAIRMAN. Let the gentleman finish there.

Mr. OSMERS. I was just going to ask for the gentleman's information, how does the * * * yield compare with the bomb that hit Nagasaki? That might give an answer to the gentleman's question.

General SCHRIEVER. Well, the Nagasaki bomb was 20 kilotons, and this would be * * * a factor of * * * times greater.

Mr. OSMERS. * * * times what hit Nakasaki?

General SCHRIEVER. I beg your pardon; * * * times.

Mr. ANFUSO. A similar missile, then, if the Russians had it, could destroy New York City?

General SCHRIEVER. When you start talking about megaton yields and accuracy of * * *, you are not very safe in any city, New York or any other.

Mr. ANFUSO. Just one more question, Mr. Chairman.

What is the distance from California by way of the polar region to Moscow?

General SCHRIEVER. We can check that.

Mr. ANFUSO. Is it less than 5,000?

General SCHRIEVER. It is less than 5,000. I think it is between 4,500 and 5,000.

The CHAIRMAN. Just go ahead, General, with your charts.

Mr. MCCORMACK. I have a question.

The CHAIRMAN. Mr. McCormack would like to ask a question.

General SCHRIEVER. This in essence completes what I had to say. I wanted to get across the importance of concurrency, planning, and programing together, in order to compress the time schedule, and then show you the sort of program we have for the force buildup.

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. General, when the Minuteman is perfected and completed, does that mean that the Atlas and the Titan are pretty well outmoded, to the best of your opinion?

General SCHRIEVER. I would say the Atlas and the Titan would have a uselfulness through the sixties. Percentagewise and in numbers, the Minuteman, if we have a succesful development program, we will have many more Minutemen than we will have of Atlas and Titan types.

The CHAIRMAN. Any further questions?

Mr. MCCORMACK. Has any consideration been given to the use of your bombers for projection purposes?

General SCHRIEVER. Yes, sir; there is quite a bit of work going on in long-range air-launch missiles, including a ballistic missile type. This comes under another division of General Anderson's, which he mentioned, Detachment 1, in Dayton, Ohio. We work closely with them, but they have the management responsibility for that.

Mr. MCCORMACK. I think the committee would be interested in that, not to press it now, but I know I would be interested in getting what

information I can, because I can see how valuable that would be as a part of not only our national defense but our striking power.

General SCHRIEVER. That is right; the Air Force considers this an important development.

Mr. MCCORMACK. Because then you would have a moving site.

The CHAIRMAN. Any further questions?

Mr. CHENOWETH. I would like to ask just one question, Mr. Chairman.

I would like to know, in the event hostilities would start tomorrow, just where are we in this missile picture? What have we got? Where would we be?

General SCHRIEVER. If hostilities started tomorrow * * *

Mr. CHENOWETH. How long would it take to get one?

General SCHRIEVER. As I pointed out, we hope to have the beginnings * * * in June and July of this year at Vandenberg.

Mr. CHENOWETH. Is it the general feeling that the Russians have them now?

General SCHRIEVER. Well, this is the great debate. As I say, the Russians say they have them, and it is really hard to say. * * *

Mr. CHENOWETH. Thank you.

Mr. MCDONOUGH. We have an IRBM that is operational, however, don't we?

General SCHRIEVER. * * *

Mr. MCDONOUGH. What is their range?

General SCHRIEVER. * * *

Mr. MCDONOUGH. What kind of operational missiles do we have at the present time—Nike?

General SCHRIEVER. I have been so busy working in the ballistic missile field I am not sure I can answer that completely.

The Air Force's Matador is operational.

Mr. MCDONOUGH. The Nike?

General SCHRIEVER. That is an Army missile. They are operational; yes.

The Bomarc.

General ANDERSON. That is not yet operational.

The CHAIRMAN. They are short-range, aren't they, 1,500 miles or less?

General SCHRIEVER. I don't know the operational status of the Snark now.

General ANDERSON. * * *

The CHAIRMAN. Then we do not have an operational IRBM.

Mr. MCDONOUGH. Why was the Regulus discontinued?

General SCHRIEVER. I had better let the Navy answer that one.

Mr. TEAGUE. I would like to ask a question, Mr. Chairman.

Mr. MCDONOUGH. It was an operational missile.

General SCHRIVER. I understand they have a limited number in operational category today.

The CHAIRMAN. Mr. Fulton wanted to ask a question.

Mr. FULTON. Could I comment on that? * * *

Mr. TEAGUE. Mr. Chairman.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Mr. Chairman, I am interested in the same thing Mr. Hall was talking about. I don't know how apppropriate this ques-

tion is to you, but how good is our intelligence? What can we learn from electronics as to what is stationed around Russia in missiles? We have little chance to travel in Russia. We can't learn from what is published in the newspaper. So what can we learn from the electronics we are able to place around the country?

General SCHRIEVER. Mr. Teague, I would like to answer you.

Mr. TEAGUE. This is not a proper question?

General SCHRIEVER. This is just not one I can get into.

The CHAIRMAN. May I say this to the gentleman from Texas: We have plans to have the CIA appear in executive session.

General SCHRIEVER. I think this would be the more appropriate group.

Mr. MCCORMACK. If you get as much out of them as the select committee got out of them, you won't know any more than you do at this time.

Mr. TEAGUE. The Russians have never lied about anything of this nature, according to Senator Symington. Whenever they have said they had this or that, it has turned out that they had. Is that generally true?

General SCHRIEVER. I can't categorically answer that. They certainly have produced in a number of instances when they said they had done something or were going to do something. Usually it is after they had done it. We have underestimated them at times, and we have overestimated them at times.

There are studies that have been made with respect to just the point that you touch on, but I haven't reviewed them recently enough to be able to hazard an answer to that.

The Rand Corp. has made a number of studies of this particular thing.

Mr. TEAGUE. May I say one thing in complete secrecy?

The general went to the school I went to and graduated 1 year ahead of me. It is one of the best schools in the country.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. You spoke, of course, of the proposed installations in Britain, the fact that they are going into operation now in IRBM's.

We do have plans in * * * and proposed in * * * for IRBM installations, so we are making progress on these bases. With the political difficulties out of the road, I think we have a tremendous advantage on Russia in that we can use these IRBM's quicker and at more dispersed points, while they will have very few ICBM's, which must travel a long distance, like the old Big Bertha that did at Paris. So strategically I believe we are moving along.

I wanted to explain to the gentlemen from Texas and New York when they raised the question.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. Mr. Chairman.

General Schriever, of course in answering my question, which is primarily along the same line as the gentleman from Pennsylvania has mentioned, and that was actually how many squadrons we have deployed in Europe or in any of the other places that are prepared today to launch this IRBM missile. Isn't it a fact that we actually do not have them there?

General SCHRIEVER. We have the first squadron's worth of missiles and all of the equipment over there, and we are in the process of * * *. It is moving quite fast. Our present target is by the end of * * * turned over to the * * *.

Mr. SISK. That is by the * * *.

General SCHRIEVER. By the * * *.

Mr. SISK. Now, let me ask you one other question in connection with this, and I hope that the question is clear.

I understand there has been some controversy in the use and handling and deployment of squadrons with this IRBM as to whether it be left as a mobile or flexible weapon or whether you put it in hard bases, and the Air Force has generally taken the position it must be in hard bases, and therefore it has created a political problem. For example, let's mention Italy or certain other countries, due to the necessity of the ground, going into a hard-base setup. Why is the Air Force opposed to the use of this weapon as a flexible or mobile unit?

General SCHRIEVER. We are not opposed to it. The only thing is, in our best judgment this is * * *.

Mr. SISK. I know the Army feels the Jupiter is and can be used as an effective mobile weapon; is that correct?

General SCHRIEVER. That is correct as far as I know now.

Mr. SISK. I am not trying to take sides here, but it is the Air Force's feeling generally that it is not a good mobile weapon, and it should be in more or less hard bases; is that correct?

General SCHRIEVER. * * *.

Mr. SISK. But isn't it a fact that the political problem, that is, the securing of the bases and the willingness of the people to permit those bases to go in, isn't that proving to be a really stupendous problem in many of these countries?

General SCHRIEVER. * * *.

The CHAIRMAN. Isn't there a safety factor involved too in reference to placing the missiles in hardened receptacles? Would that have anything to do with your decision in Europe?

General SCHRIEVER. Actually, just intuitively, if you put them in a hard base, this would be a safer system than if you fired them from above ground, because the plan would be to * * *.

The CHAIRMAN. And those that live in the vicinity would feel much safer if they were in a hardened vessel of that sort?

General SCHRIEVER. They probably would, but I think this is a matter that is completely blown up out of proportion. We had a couple of mishaps early in the program, but we haven't had a catastrophic failure of that kind now in months and months.

The CHAIRMAN. Let me ask you this. This is the question I wanted to get to:

The Air Force program of deploying these missiles overseas, the IRBM, has been predicated on the thought or the belief that Russia was not able to deliver an atomic warhead missile into the United States at this time; isn't that right?

General SCHRIEVER. I don't believe I can answer that * * *.

The CHAIRMAN. Isn't it our belief that the Russians cannot deliver the long-range intercontinental ballistic missile into the United States—well, deliver it at all at this time?

General SCHRIEVER. No; I think it was generally the policy of the United States to increase the overall deterrent strength of the free world and provide our allies with some of the more up-to-date weapons. That was my thinking on this, and I believe this was generally the underlying philosophy as to IRBM overseas deployment.

The CHAIRMAN. Rather than the ability of Russia to deliver a missile, an ICBM?

General SCHRIEVER. We always knew that they would eventually have a capability of delivering ICBM's against us. We didn't know just exactly when.

The CHAIRMAN. We didn't think it would come in the next year and a half or 2 years, though, did we?

General SCHRIEVER. Well, most estimates have not differed too much. They have varied anywhere from * * *.

The CHAIRMAN. Are there any further questions?

Mr. RIEHLMAN. I would like to ask the general a question, Mr. Chairman.

You have stated that we have been successful in flying one squadron to England. At what rate will we fly additional squadrons during this year of 1959?

General SCHRIEVER. We have a total of four squadrons scheduled for there. I don't know whether I have got that on the chart, or not. I have got that here. I will have to look it up exactly.

The last squadron becomes operational in * * *.

Mr. RIEHLMAN. In other words, we are committed to four squadrons for England?

General SCHRIEVER. Yes, sir; for the United Kingdom.

Mr. RIEHLMAN. Now, they are manned by people who have been trained in this country and are with the British troops; is that correct?

General SCHRIEVER. That is right. We have had Royal Air Force people over here for months in training, in factory training. We have not had facilities ready for crew training at Vandenberg, so the first unit or portion of the first unit will be trained on site in the United Kingdom, but the second, third, and fourth squadron, the people will get complete training, individual and crew training, in this country.

Mr. RIEHLMAN. Now, do we have any other countries that have people here observing this program and are under training at this time?

General SCHRIEVER. No, sir.

Mr. RIEHLMAN. So if we had agreement with France or Greece or Turkey we would have to bring those people here for training or furnish men to man a squadron in that country; is that correct?

General SCHRIEVER. We would have to man it ourselves, or bring people here, and we have to figure particularly if there is a language barrier, we are talking about * * * months.

Mr. RIEHLMAN. Are we in a position to furnish the men to man one of these units or squadrons in another country?

General SCHRIEVER. Yes, sir; as a matter of fact, we have trained one squadron under the Strategic Air Command. I don't know whether their planning goes further than that, but one squadron has been trained, and those people are over in the United Kingdom, as well.

Mr. RIEHLMAN. They are assisting in training people?

General SCHRIEVER. Yes, sir; they are assisting and getting on-the-job experience, and so forth.

The CHAIRMAN. Any further questions?

Mr. MCCORMACK. Will you elaborate a little more on this question I asked you but didn't press, about what the Air Force is doing in the use of our big bombers for projection of the war heads, air launch?

General SCHRIEVER. I hate to give this answer in detail, but, No. 1, we do have—I might get some help here, but I will start.

This is the air launch program. General, would you rather take this on?

General ANDERSON. * * *.

Mr. MCCORMACK. That would be quite an advance if successful, wouldn't it?

General ANDERSON. Yes, sir.

Mr. MCCORMACK. A tremendous advance.

General ANDERSON. * * *

Mr. MILLER. Will the gentleman yield?

Mr. MCCORMACK. In just a minute.

Following what you stated, General, you have confidence it can be perfected?

General ANDERSON. I feel confident about it, myself. I know there is some disagreement in scientific circles, but I know also that there is some agreement in scientific circles, so we think we have to prove it out one way or the other.

Mr. SISK. Mr. Chairman.

Mr. MCCORMACK. I yield to Mr. Miller.

Mr. MILLER. Didn't we try something like that about 1955, make some mockups and studies of piggyback planes?

General ANDERSON. I wasn't working with the Air Force in those days. At the period of time you were speaking of I was Director of Weapons Systems Evaluation Group in the Joint Chiefs of Staff, Office of the Secretary of Defense.

What do you think about that, General Davis?

General DAVIS. I can't think of anything. Navaho was sort of a piggyback.

Mr. MILLER. We went on tour with the Hébert committee, and at Fort Worth they had a mockup of wood already made.

General DAVIS. Perhaps at Fort Worth you are referring to the B–58 with the missile pod underneath.

Mr. MILLER. What happened to that?

General ANDERSON. The airplane has to carry that all of the way to the target. Instead of releasing a bomb from the B–58 they release a missile pod. We are building a missile called Hound dog right now for the B–52 fleet; it is a much shorter range than I am talking about today. * * *

Mr. SISK. I have one question of General Anderson, or General Schriever.

In reference to the past comments by Mr. McCormack, are you prepared to say anything—maybe it has no part in this picture, but speaking about the weapons systems, what about the weapons system now being worked on by North American?

General ANDERSON. As of now, that is a development program. * * *

Mr. SISK. That is some 4, 5, or 6 years away, based on leadtime, and so forth.

General ANDERSON. * * *

Mr. SISK. But it is being actively pursued and would be in a sense, and I wanted to ask General Schriever a little while ago when he had his first chart up there with reference to lagtime, discussing the Atlas chart, is this * * * weapons system being pursued generally along a similar line of approach to that program where you are planning not only the actual research and development on one side, but you are moving into various phases of it? Is that correct, or not?

General SCHRIEVER. I will have to let General Anderson answer that.

General ANDERSON. At this stage, no, it is a development program * * *.

Mr. SISK. That is all, Mr. Chairman.

The CHAIRMAN. I asked you, General, in open session something about our protection to the north, the DEW line, the Pine Tree line, and this other line there. Do you have anything you would like to give the committee on that?

General SCHRIEVER. The present DEW line is of no value as far as giving you warning of ballistic missile attack; it is strictly a system against aircraft. What is called the BMEWS (ballistic missile early warning system), with the first radar installation going into Thule, and there are two more planned—this is not under me, but there are two more planned—I think they plan to get into operation sometime in 1961, which would be the earliest we would have any warning.

I would like to be sure to correct the record on that date because I am just using my memory on that, but I think it is 1961 before this becomes operational.

The CHAIRMAN. We are moving forward on that plan, but it will be 1961 before it is operational?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. At that time do you believe it will be a system of detection that will be without flaw?

General SCHRIEVER. I don't know there is any system that can be completely without flaw, but I think under normal circumstances this system would give us about 15 minutes' warning of a ballistic missile attack.

The CHAIRMAN. And it would be reasonably efficient in making returns and giving warning, would it?

General SCHRIEVER. This depends on the communications system, it ties right into the air defense system, and, of course, the communications system planned is such that the warning should be instantaneous at least to the air defense net.

The CHAIRMAN. To sum it up, our main deterrent for war is still the bomber?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. The reliance is not now on the missile.

General SCHRIEVER. That is right.

The CHAIRMAN. Any further questions?

If not——

Mr. HALL. Yes, Mr. Chairman, I would like to return to my line of questioning now, if I may.

The CHAIRMAN. Mr. Hall.

Mr. HALL. Before we went into executive session I was asking you some questions about the type of missiles, about the type of missiles, if you know—you don't know, of course, but you have to assume that the Russians, if you accept the fact they have showed in their Lunik missile, in the area of the moon to the sun, that they are superior to us in at least thrust; is that right?

General SCHRIEVER. There is no question but that they have larger thrust engines than we do.

Mr. HALL. Now, do you have any idea how they have been able to procure that additional thrust? Has it been by the use of more exotic fuels, the use of better designed single-engine instruments, or by the use of multiple-rocket instruments, or a combination of the three?

General SCHRIEVER. They undoubtedly are doing development work in exotic fuels, but it is generally believed they are using essentially the same type fuels in their engines as we are using in ours at the present time.

Mr. HALL. Do you mean they are using the same type liquid fuels?

General SCHRIEVER. Same type liquid fuels; yes.

Mr. HALL. All right; I didn't mean to interrupt. Go ahead.

General SCHRIEVER. The reason they have larger thrust in a single chamber is the fact they simply design a larger engine to begin with. If I were to postulate the reason for that, it is because they probably started design on a long-range missile or started working aggressively on it before we did, and were planning on the delivery of perhaps a larger payload because of the start of the art in warhead development.

We have ample thrust in our ICBM's to get the payloads that I have mentioned, the intercontinental distances. As a matter of fact, we will be getting larger payloads that distance with the engines we now have.

Now, the single-barrel engine is a nominal 150,000 pounds. The North American engine has been uprated from an original 120 to 150, and it can go another * * * pounds, perhaps, up to * * * pounds of thrust. The Aerojet engine was designed at the low end of the spectrum at * * * to begin with, and there is no reason with growth why that engine cannot go up to about * * * pounds of thrust—single barrel, I am talking about.

Mr. HALL. Then I gather that you fear that our thermonuclear devices are more refined than theirs, and it became necessary because of their lack of refinement in those devices to devise a larger thrust engine to deliver that warhead; is that right?

General SCHRIEVER. I am not qualified to answer that. I said that they started sooner in the development of the long-range missile, and at that particular point their nuclear development probably hadn't reached the refinement that ours had when we started very aggressively after a ballistic missile capability.

I wouldn't be qualified to say where we stand today relative to refinement of the warhead.

Mr. HALL. Now, these solid propellant missiles, of which you spoke, is the main problem there one of guidance after the missile is launched, in that it is necessary to have some heavier type structure in order to properly deflect the gases or to contain the gases that

escape from the solid propellant; is that the reason for the additional weight?

General SCHRIEVER. No, the * * *. This has not been done except under test conditions in solid propellant engines, but it looks like the most promising approach to us.

Mr. HALL. Even so, under the present state of development, it will be necessary to have these extremely * * * within that instrument; is that right?

General SCHRIEVER. No; I would say even with today's state of the art, if we were to freeze immediately, we would probably get * * *. Now, we are shooting for something in the order * * *.

The CHAIRMAN. Any further questions?

Mr. HALL. That is all.

The CHAIRMAN. Any further questions at all?

Mr. HALL. Mr. Chairman, I would like to ask one more question that requires a very short answer.

The CHAIRMAN. Go ahead.

Mr. HALL. You stated, I believe, that we had to date, fired 32 Thor missiles; is that right?

General SCHRIEVER. Yes, sir.

The CHAIRMAN. How many of those firings were successful?

General SCHRIEVER. I would have to give you a record of that. About half of them were completely successful. The rest of them partial successes, and then we had several that you simply have to say were complete failures.

Mr. HALL. All right, now what is the ratio of success of the liquid fuel firings; half, or 25 percent?

General SCHRIEVER. In the Atlas program we have had about 75 percent success, which has been phenomenally good. In the Thor it has been running between 50 and 60. You would think with a single sustaining engine you would do someawht better than that, but the Atlas has been actually a little better in its test program from a reliability standpoint than the Thor has.

The CHAIRMAN. May I ask you this question, General: Didn't you build five Atlas prototypes?

General SCHRIEVER. I don't quite understand your question. We have fired 20 Atlases already in the test program.

The CHAIRMAN. I am thinking of someone else. With the lunar probe you had five missiles?

General SCHRIEVER. The lunar probe, the first stage were all using Thors.

The CHAIRMAN. Now, did you build five prototypes for the lunar probe?

General SCHRIEVER. No, sir, we just built three, that is all.

The CHAIRMAN. I got the impression from my colleague, Mr. Fulton, that we had two extra there that were not available, not used.

General SCHRIEVER. Actually, there is a Thor-Able series which has been a reentry test vehicle, and the second stage of the Thor Able is the same stage we were using on the lunar shot, but the lunar shot had a third stage in addition. We do have still a number of so-called Thor-Able shots to make in the reentry test program.

Mr. FULTON. They are interchangeable?

General SCHRIEVER. The second stages are interchangeable.

The CHAIRMAN. When are you going to proceed to use those?

General SCHRIEVER. Well, we used one last month and in this particular case we had a completely successful first stage, and we didn't get ignition of the second stage. We have about * * * more shots. They will be fired this year.

The CHAIRMAN. As I read that, it seems to me you were so close to success in two instances there that you would proceed to use the other missiles if there were additional missiles available?

General SCHRIEVER. Well, we were not directed to do so. We had three shots. It would take a little time to put the necessary guidance and control system that is different from the Thor-Able shots. Also, all these Thor-Able shots have Bell Telephone Laboratory guidance systems involved. You may recall my difficulty on the "mouse" situation last year. We are not putting any mice in them now, but we do have guidance in the second stages now of the Thor-Ables in order to get precise hits out in the impact area, and also to give us some early flights on the BTL guidance, which will be part of the Titan program.

The CHAIRMAN. When do you think they will be ready for use? You said you did not get the order to go ahead with them.

General SCHRIEVER. They have been in the reentry test vehicle program. They would have had to have been ordered out of that and redirected ino a lunar probe program.

The CHAIRMAN. They have not been ordered out of that into a lunar probe?

General SCHRIEVER. No, sir.

The CHAIRMAN. Do you think they should be ordered out of that into the lunar probe?

General SCHRIEVER. That is a matter of judgment. There are certain other space probes that we have programed, * * * We are very anxious to get the information that we want on these reentry tests. My judgment would be that we should not redirect these to the lunar probe.

The CHAIRMAN. Well, they are available if you wanted to redirect them, and your judgment is that some other program has a priority over that program?

General SCHRIEVER. Well, in my mind, yes; but there are other things that can be done. There are other ways of doing the same thing, but nothing could be done just overnight. It takes time to get everything set to make a lunar shot. I personally would rather see an attempt made at a larger payload than we can lift with a Thor-Able combination, and use that for further space probes.

The CHAIRMAN. How much further removed, then, will be your probe with a larger payload, in time?

General SCHRIEVER. The Atlas would take up a payload—using the Atlas as a first-stage booster, would take up a payload in approximately the same magnitude as the Lunik, a little bit less, a hundred or so pounds less payload, with the proper combination of second and third stage.

The CHAIRMAN. But I mean if you don't use what you have available now and almost in readiness to be used for the lunar probe, how much longer is it going to take you then to use the other method of building up a rocket with a larger payload?

General SCHRIEVER. Well, of course, there is only a limited number of vehicles available for all of the purposes that have been laid down.

The CHAIRMAN. Don't you think that lunar probe is so important as to use another one of these rockets to try to make it?

General SCHRIEVER. Well, I think it is very important, but there are certain other space projects that I think probably are equally important, or perhaps more so, and these have been directed.

The CHAIRMAN. The reason I ask is because a select committee passed a resolution unanimously asking the Department to go ahead and use the other two available missiles for that lunar probe. You feel, though, that would not be wise?

General Anderson.

General ANDERSON. That is not a decision the Department of Defense can make. This program is under NASA now. Actually, NASA has on its program two probes with about $1,990,000 lined up against them, but they have not directed that these two probes be fired.

The CHAIRMAN. If they directed the firing of those two probes, you could do that in short order, couldn't you?

General ANDERSON. I will refer that to General Schriever.

The CHAIRMAN. We would be glad to have General Anderson or General Schriever, either one, answer that. If it embarrasses you to answer the question——

General SCHRIEVER. No, no, I can't give you the exact time. We have presented dates that we could do certain things. I think it would take between 3 to 5 months in order to get another shot off; in other words, to make the necessary modifications to get another lunar probe off, using the basic Thor Able combination.

The CHAIRMAN. Well, now, if we don't use them, it will be much longer, wouldn't it, to get another shot to the moon?

General SCHRIEVER. Well, I don't know what the Army can do. The Jupiter has the same sort of basic payload capacity as the Thor. They are very similar. There aren't any extra Atlas boosters lying around either because they are all taken up for specific programs.

As a matter of fact, we don't know where we can find all of the boosters that are desired for programs that have been directed on us or that NASA and ARPA want to direct on us, so it is a matter of judgment as to what you want to do and what you consider to be more important from a scientific standpoint and from a prestige standpoint.

The CHAIRMAN. Would you give the Jupiter C the lead then on this lunar probe and take it away from Atlas, because as I read it, it looked like you were very close to success with that probe?

General SCHRIEVER. Yes.

The CHAIRMAN. Then all of a sudden, although you had two of these missiles available you backed away from it and decided to try something else?

General SCHRIEVER. No, sir. We didn't back away from it.

The CHAIRMAN. I am not trying to put the burden on you, but the Government did.

General SCHRIEVER. That is right. As General Anderson pointed out, that is not our prerogative.

Mr. FULTON. As a matter of fact, General, you had three programed and you successfully completed those. The Army has two, one remaining to be done.

General SCHRIEVER. One remaining to be fired.

Mr. FULTON. And you have the equipment on the Thor Able but it is on other programs and the question is whether to use it in the deep probes, or whether to put it back into the lunar probe area.

General Boushey is here, who, I believe, has had some part in the programing of this particular project.

General BOUSHEY. May I make a remark, sir?

The CHAIRMAN. We want to hear you, General.

General BOUSHEY. I would like to remind everybody that the unanimous recommendation of the select committee was made January 2, and Lunik appeared in the skies on January 3. The payload differences between the Thor Able configuration, which on our three lunar attempts is so much lower than the Lunik, that it seemed to me it would be more wise with an attempt were going to be made to do as General Schriever suggests, based on an Atlas booster even though this might take more time.

I discussed this with General Schriever when he was in the Pentagon, I imagine about 2 weeks ago. Of course, as General Anderson has pointed out, these scientific probes are exclusively the province of NASA, and if they want us to do something, they have to ask before we have the privilege.

The CHAIRMAN. As I understand you, General, what you say is this: Even though we were successful with the Atlas-Able shot, the payload was so small that against the Russian success we couldn't make a favorable comparison.

General BOUSHEY. With the Thor as the booster, sir. It might be scientifically very valuable, but the chances of success—again I got this from General Schriever's organization and from General Schriever—the chances of success appeared so marginal that the recommendation would be, if we were asked, I believe, to base it on the Atlas with better guidance and a better chance of success. Is this your understanding, General Schriever?

General SCHRIEVER. Yes; although I don't quite agree that the chance of success of the Thor would be highly marginal. I think, of course, having fired three, that your chances of succeeding go up, because we learn things as we go along, but I heartily agree from an overall prestige standpoint we probably would not gain too much by putting a small payload up there after the Russian Lunik. On the other hand, from a scientific standpoint, it has quite a bit of value. We are talking about something on the order of 80 pounds of payload versus some 600 or 700 or 800 pounds.

The CHAIRMAN. When the select committee passed that resolution unanimously, we didn't know the Russians were going to put the Lunik up in the next day.

Mr. FULTON. We were competitive but not as to size. We said we better get on with the moon shot because the Russians will do it.

General SCHRIEVER. We would like to try from a personal standpoint because you don't like to quit when you haven't achieved your objective. We got pretty close. We came within 2 percent of the

velocity required on the second shot, and third shot we had perfect first and second stage performance and failed to get ignition on the third stage. It is just bad luck.

The CHAIRMAN. It was a tragedy there.

General SCHRIEVER. The Army came reasonably close, too. Their first shot got up to about the same velocity as ours—our second one.

Mr. FULTON. Getting away from the size of the payload, wouldn't it be strategically to your great advantage as the Air Force to be able to orbit the moon regardless of payload, and secondly—I don't know whether I should mention the particular system, but don't you want to prove out to the area of the moon to the Air Force certain systems to contract things?

The CHAIRMAN. And wouldn't pictures of the moon from a relatively close point of view be very helpful?

General SCHRIEVER. I think you would have to say that all of this, at least at the moment, would fall in the area of scientific endeavor and, therefore, would not directly be the responsibility of the Air Force. There is no question but that we would benefit by what we would learn but then this is a matter for NASA to make a decision on.

Mr. FULTON. But that is a strategic gain, if we get these experiments out to the vicinity of the moon we are then keeping America safer and put that into comparison to the two deep probe shots possibly to Mars or Venus that are in prospect for purely basic scientific information.

Wouldn't you gain much more by having your shots and put the effort on to these deep probes you are talking about, under NASA?

General SCHRIEVER. Mr. Fulton——

Mr. FULTON. We want you to stand up for yourself. We want to balance things here. Maybe we are not all for NASA.

General SCHRIEVER. I am going to look at it from the standpoint if I can imagine in my own mind—and I fail to do so at the moment—a military mission involving the moon in any sense at the moment. I am sure that one of these days we will.

Mr. FULTON. Well, I will refer to General Boushey for that. I think he was the first one publicly to say that it has a security value, 2 years ago.

General SCHRIEVER. Then I will let General Boushey speak for himself.

Mr. FULTON. Have you not said that publicly, General?

General BOUSHEY. Yes, sir.

The CHAIRMAN. It does have a security value.

Mr. FULTON. From the Air Force point of view.

The CHAIRMAN. Any further questions?

If not, gentlemen, it is nearly 5:30 and I want to compliment all of the members of the committee for remaining here at this late hour and staying from 10 o'clock on, and I especially want to compliment the Air Force for a very, very fine presentation on a subject that is of fundamental importance to this committee, General Anderson, General Schriever, General Boushey, Colonel Roadman, and all of you for what you have done. We appreciate it very much.

Mr. FULTON. And Mr. Donovan who waited.

The CHAIRMAN. Now, General, do you have something more you want to say?

General SCHRIEVER. No, sir.

The CHAIRMAN. Well, I have this further admonition to the members of the committee. Tomorrow morning there is a shot, but a different kind of shot. It is a photograph of the committee. We will meet at the Veterans' Affairs Committee meeting room at 10 o'clock tomorrow morning.

(Whereupon, at 5:26 p.m., the committee recessed until 10 a.m., Wednesday, February 4, 1959.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Wednesday, February 4, 1959.

The committee met at 10 a.m., in room 356, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. Let us come to order.

This morning we have the Navy in open session and before we begin I want to publicly thank the chairman of the Veterans' Affairs Committee, who is a member of this committee, for lending us the use of this committee room for the purpose of having our picture made and also offering to lend us the use of the committee room at any and all times when his committee is not actually in session. That is really something to appreciate.

Our own committee room is now in the hands of the architect and contractor and we think in the next 2 weeks we will have our committee room in shape so we can meet there, but it will not be a finished committee room because it is being put together in such a hurry. Nonetheless, it will give us a home and place to meet. I hope we can announce a date for moving to our own quarters in a short time. In the meantime we wish to thank Congressman Teague, chairman of the House Committee on Veterans' Affairs, for lending us this room.

Now before we proceed, I want to say this to the members of the committee: I have just read in the daily press a statement of the Secretary of Defense, Neil McElroy, to the effect that the American stockpile of operationally ready intercontinental ballistic missiles will be within a few of the Russian total by the end of the year.

I want to state that our testimony to date does not support this finding. I want to say further that this committee will welcome the Secretary of Defense at a later date to appear before it, giving the committee the benefit of his knowledge of the development and capabilities of our intercontinental ballistic missiles, at this time and by the end of the year, and also making a comparison of the capabilities of this country with that of Russia.

Mr. Osmers.

Mr. OSMERS. Before we hear the first witness, I would like to make a suggestion, sir. As the testimony has come in from civilian and military branches of the Government, it seems to me that it might be a worthwhile staff task to try to make a chart showing the interrela-

tionship of the military and civilian space agencies of the Government and how they overlap and coordinate. It has been difficult as we hear from the Air Force, and NASA, and so forth, and that is just a suggestion that I make to you, Mr. Chairman.

The CHAIRMAN. You have heard the suggestion; is there any debate or opposition?

If not, Mr. Ducander, will you take that into consideration.

Mr. DUCANDER. Yes, sir.

The CHAIRMAN. Now this morning the first witness is Admiral Hayward, Director of Research and Development, Rear Adm. J. T. Hayward.

Admiral Hayward, we are very happy to have you here before this committee this morning. We are making an intensive study of this situation. We appreciate whatever light you can give us on this matter.

You have a prepared statement there?

Admiral HAYWARD. Yes, Mr. Chairman, I do.

Mr. MCCORMACK. I would like to say, Mr. Chairman, that Admiral Hayward appeared before the select committee and made a profound and favorable impression upon the members of the select committee and as chairman of the select committee and a member of this committee, I am glad to welcome you back here.

Admiral HAYWARD. I am delighted to be here.

Mr. FULTON. May I join with Mr. McCormack in saying that Admiral Hayward is one of the best witnesses we had and a great supporter of research and development.

The CHAIRMAN. Proceed with safety, you have a lot of supporters on this committee.

STATEMENT OF REAR ADM. JOHN T. HAYWARD, ASSISTANT CHIEF OF NAVAL OPERATIONS, RESEARCH AND DEVELOPMENT, U.S. NAVY

Admiral HAYWARD. They say you should never follow an animal act, but we will do the best we can. I did recognize Mr. Fulton [in reference to a newspaper photograph of Mr. Fulton with a space monkey brought by the Air Force.]

Mr. Chairman, I will discuss briefly the Navy and the space age and will welcome any questions you may have. I will be followed today by Admiral Masterson who will discuss the Navy guided-missile program and by Admiral Raborn who is the head of, and our No. 1 expert on, Polaris. As our final speaker, Captain Wagner will describe a very necessary adjunct to all these programs, the Pacific missile range. I hope that between us we can provide a comprehensive if brief, view of our Navy's endeavors in these fields of modern weapons.

I would keep the classified portion of the briefing until this afternoon if that meets with the approval of the committee. If anything comes up I feel we should discuss in executive session, I will say so.

The CHAIRMAN. Let us proceed in open session as long as we can.

Admiral HAYWARD. Yes, sir.

Now to turn to the subject of space, I will not belabor the reasons of why the Navy is interested in space because the events of the last

16 months have made it quite evident that a nation and the military arms of that nation must choose one of two courses. Either improved accomplishment of their objectives through use of space technology, or alternately, the placid acceptance of being second best and the inescapable road to oblivion that follows.

It is with great pleasure that I see this is called a Science and Astronautics Committee because science goes across the board and does not just apply to space.

The first course, and that only, has been part of Navy thinking since 1942 when the first propositions were made by the Navy for launching of artificial earth satellites. The sequence of events since then is well known: The IGY satellite effort, the unfortunate and unwarranted reaction to Vanguard, and the many recent displays of Soviet and U.S. space capabilities. The results of this first thinking have been grandiose and overwhelming. Although world interest and national thinking have matured somewhat in relation to this new area of man's activity, the United States is still in the throes of adjustment and is still mumbling, "We must get organized." It has not been easy to keep goals clearly defined and objectives firmly in view during this period of frantic activity and changing responsibilities.

Attention has been directed to launching vehicles with an enthusiasm that has almost obscured the reasons for their existence. Pounds-in-orbit has become a fetish that has led to several embarrassments. The only true objective should be the effectiveness of the satellite or experiment, and not the method, the agency, or the number of rocket casings floating in space. We might do well to note that the much maligned, little, experimental Vanguard is the only U.S. object in space that is still faithfully doing the job it was designed for—after almost a year in orbit. It goes around still transmitting on 108 megacycles, still giving us the skin temperature. It has traveled 105 million miles up to the 1st of January. This is equivalent to 438 trips to the moon. It is 12 million miles beyond the sun and it is three trips to Mars, even with the varied distance. This gives rise to the feeling that we must not lose sight of what you are putting in space. It is not pounds in orbit. This example—there are no Russian satellites, no other American satellites that are broadcasting today. This gives rise to one thing and one thing that it is most important for this committee to see and to realize, that it is the development of components that makes it possible for this thing to work.

The component that makes that possible is the solar battery. The solar battery is an effective power source and we thought, of course, that this particular object would only last maybe 200 years. Scientists now feel that it can last 2,000 years; that is the optimistic opinion. How long the solar batteries will withstand the meteorite blows, or if it runs into anything, of course, this would put them out, but it is a serious and sober thing to think because when one thinks of just the vehicle side of it you lose sight of what is in orbit and you all know and are familiar with what the press has said about the Vanguard and the opinion that this program was a failure.

Now this supports the thought that I really want to make clear: The Navy intends to use space to accomplish naval objectives, and, of course, to prevent space from being used to the detriment of those objectives. With the national objectives in mind, we must pursue

those courses of action that contribute directly to the Navy's capabilities. Practically every aspect of space endeavor is related in some manner, but we must temper our participation with the cold facts of feasibility or degree of threat. Right now we are extremely interested in intelligence, navigation, and communication by satellites. The possible contributions of these systems to our Polaris weapon make their vigorous prosecution essential. This does not indicate, however, a lack of interest in ship surveillance, meteorology, and manned space vehicles. Each and every military aspect must be part of our space program.

Because of the tremendous cost involved with space programs and the need to husband our technical knowledge, there must be one national space program. Similarly, there must be one agency to be responsible for the development and execution of that program. Obviously, our national space program must be broad in scope and all encompassing, but at the same time, and this is most important, it should be sufficiently complete to include military programs of the services.

The National Aeronautics and Space Administration is charged with a responsibility to the national program for basic research and civil scientific effort. The majority of these projects, however, are intended to produce scientific knowledge, psychological advantage, or strategic advancements, with all the complex interchange of communications and policy that such systems engender. The services must have a mechanism that insures fulfillment of military needs. Navy operational needs can be summed up by an example such as a fleet commander in the Indian Ocean choosing package No. 3 from the shelf, launching it as a satellite, and recovering his intelligence answer within an hour. That is the tactical concept, and is the Navy's view of an objective goal.

In the newspapers you read a lot about ICBM's and how many missiles the Russians have, but war is complex; it is a spectrum, not just the megawar field. The national strategy has to be one of economic, political, psychological, and military needs in peace as well as war. If you face up to the challenge that we are faced with, you will face it across the whole spectrum not in just anti-ICBM's, or ICBM's, or Fortress America. We are a member of the free alliance and if we go to this concept the free alliance will die. Today this challenge to Western civilization is across the board.

I always like to put my physicist, third-class hat on when I discuss this, it covers the microwar, the miniwar, the mesawar, monowar, and the megawar. We do a disservice to our people to just tell them of the megawar, because you are facing this challenge and we have faced it since I last appeared before the select committee. I do not know if that precise picture was envisioned by Congress in drafting the Space Act of 1958, but I do know that the need for military application of space was well recognized. You may recall that I testified last year as to the need for adequate military representation in the space agency to the extent of proposing a military application division similar to that of the AEC. I cannot accept the concept that a single agency should have exclusive rights to space. The idea of being a user, without enjoying participation, is fallacy. I am also concerned that preoccupation with the peaceful uses of outer space may function to the detriment of military reality. And, gentlemen, after a

year of furious U.S. activity, I sincerely conclude that U.S. supremacy in space science is threatened, not by lack of talent, but by our skill in bureaucracy. I am certain that firm implementation of the intent of the Space Act, and execution of the recommendations made by the Congressional Space Committee, will yield the United States preeminence that we all desire.

Now, I should not leave the impression that all is lost, or that no progress has been made. Advancements have been achieved; the Navy does have active programs for those immediate goals I mentioned, and basic research has not suffered unduly from the battle of the agencies. The same people are still working hard hours to yield each small step forward. That is the secret of the whole problem; long hard work and the freedom to make it pay. This work is being done in many laboratories, by many agencies, and usually in great harmony.

This also goes to the complete spectrum of the challenge. It is hard work we have to tell our people. We are not going to keep our freedom unless we work hard and we have to face the challenge across the board.

Now, I have a short film that will demonstrate the type of work that I am talking about. This is the type of hard work and detailed work that has to go on before you proceed to any definite accomplishment such as the solar batteries in the Vanguard.

Now, I also would like to make the comment you are going to see the first unified monkey in existence. The Air Force introduced him to Congress. The Army rides him in their missile and the Navy trains him. Of course, to successfuliy place a man in space you are going to have to have continued research in many diverse fields of science. As you will see in this picture, you will see how we train the monkey, and we have been conducting this sort of experiment and research for years before we actually got into Project Mercury, Mr. Chairman. It has lots of application, of course, to the flight of manned vehicles.

We have a centrifuge at Johnsville which is nothing but a large arm that you put a man in and you can subject him to various accelerations. We have put Scott Crossfield in this particular acceleration device and he has actually flown the X–15 600 times. He flies the X–15 within the envelope that is required and his motions are fed back to a computer that tell him exactly and tell the doctors exactly what he has done and what has happened.

I am sorry to say, in the course of the 600 flights he has made in the X–15 to date, approximately 15 percent of them have been failures and would have resulted in crashes. Fortunately, when you crash in this accelerometer, you will see that it does not have disastrous results. But it is the type of hard work in research and development that has to go on in a component field to really be able with any assurance to place a man in space. We have also in this same device used the Dyna Soar principle to see if this was possible for man to accomplish. Of course, at this particular point, Mr. Chairman, it does not look like Ohm's law is going to work. We have not got any juice. It is just such things that make those missiles and space devices fail; it is probable that a 25-cent fuse is gone. Maybe we better turn the lights on while the electricians are working and you can ask me some questions.

I would like to say that the pictures you will see show men subjected to accelerations that no man has ever been subjected to before, up to 31 G and 21 G. You will also see a space suit in here.

[Film begins.]

This is the successful Vanguard launch that is still in orbit. This is a picture of a satellite which is still working. You are going to have to have reliability in space to a much greater degree than you have it on the ground.

This is your friend that you met yesterday and this is the cage that they put him in with his tail wired, of course, and the handle and the light you will see shortly. Incidentally, we found one of these monkeys that liked the shock and he would not do anything. You could just keep on giving it to him and he liked it. This one was not of that nature.

As you can see, he is learning to do his task. We are in the process now of getting ready for the second biomedical experiment. This is a recording of his actions. When you see what we do to the men you will see that we treat the men a lot worse than the monkey. He is anesthetized here and put into his space suit. This is like the plaster that dentists use. We encase him in this. He can move his arm and we then take him for a ride in this machine. He is in his space suit now and all encased and this is an acceleration machine. We did lose one this way that did not survive. He has got his handle there.

This next one will show pictures of the couch, the Mercury couch. We actually put this in the centrifuge and this pilot went to 21 G. One of the things they examine is to see how well it fits. If there is any skin hemorrhaging, the couch does not fit him. This is all done in coordination with NASA and with the Air Force and it is done at Johnsville, Pa. This is the only facility in the United States to do this particular work.

In all of these tests they will give him some function to perform under these particular accelerations. The couch is actually designed by the National Aeronautics and Space Administration. It is one approach to the problem of reducing the accelerations on human beings in flight.

Now when the light comes on he has to press a switch and put the light off. This is the way they measure what he can actually do under these accelerations. His handles are down by his hand. That is a view of the arm of the acceleration machine which will rotate up to the required accelerations.

This boy actually withstood 25 G in a 40-second period that he was accelerated. This gives you the ability, for instance, for a person like Crossfield to actually experience the sensations of a flight—he is going by there in that couch, so you can see he is getting a real rough ride compared to the monkey. Of course they will take him right out and examine him to see his reactions, to see whether he suffered anything and in this particular case he did have some hemorrhages up on his right shoulder where the couch did not fit tightly and, of course, an improvement has been made since these tests on this particular couch to try to increase its usefulness.

Now we found a very peculiar thing. We started off by immersing a man in water and of course there are some people who say that if the Navy is going to space, they have to go in water, but strange as

it seems we have found a man completely immersed in water can stand more acceleration than any other way. So you will see right after this a space suit that weighs a total of 700 pounds and where the subject is immersed completely in water. That is put in the accelerometer and whirled around and he can withstand in this device 30 to 35 G, which incidentally is the same as if you went from zero to 11,000 miles an hour in 30 seconds which is a real good acceleration. When we first did it partially with water up to his shoulders, we found that the acceleration resistance did not go up much at all. We had to completely immerse him in it and he has controls that he has to manipulate under these forces to see whether he could perform his particular job. He did pretty well on his balance test.

This particular force, of course, would have killed any unprotected man. If he had not been in the water, he would have been killed. Now that means that this sort of capsule might very well be used to survive extremely high impact accelerations. Of course it seems awfully strange that a man may enter space immersed in water, yet the increased capability for rapid maneuvers and accelerations may warrant the weight penalty.

We were looking around, of course, like everybody does in the research and development field, to try to find a way in which we could get over some of the fundamental limitations of man. This sort of work, of course, as I say is hard and tedious and it takes time, but it is the only way we are going to make progress, because unless you have components you cannot put a system together. Unfortunately we have had a tendency in the past to try to put a system together without components and then we invent on schedule and then we never keep the schedule, obviously. The tank is being filled up with water at the moment now.

He has special glasses on and, of course, he has his oxygen.

Mr. FULTON. He is a brave man.

Admiral HAYWARD. That is a hard way to make a living. Yes, sir, we have our doctors up there; we have some real brave men.

Mr. FULTON. Does he get extra hazardous pay for that?

Admiral HAYWARD. Yes, sir; he does. I do not know whether he can log that as flight time, however, under the general rules and regulations, but he gets hazardous pay. As you can see, he gets a rougher treatment than the monkey. The thing that amazed me was they gave him this balance test which they give all us aviators and I think he did better than I do without being whirled around at 31 G.

Of course, the Navy has not claimed water rights for space travel either, Mr. Chairman. Now this sort of work has to go on across the board in power sources, guidance, in addition to propulsion. Everybody is worried about propulsion and rightly so because naturally if you do not have the propulsion you cannot get into space but if you just have the propulsion and the rest of it falls by the wayside, you have not done your job either.

Incidentally, these facilities do not come cheaply, as I am sure most of you are aware, but you can see their usefulness in the research and development program. Now, those are all of the controls he had to manipulate under this 31 G and he did very well, actually.

There he is doing his balancing test right after the acceleration with his eyes closed which he does real well, I feel.

(End of film.)

Admiral HAYWARD. Now the reason I showed you that particular film, Mr. Chairman, was the fact that I wanted to emphasize once again the hard work and the detailed work in research and development that has to go on before one says we are really competent and capable to enter this space age to which everybody refers lightly. There is no substitute for hard work and competent people to do it. I will be pleased to answer any questions you may have in regard to the Nation's research program or our space program.

The CHAIRMAN. Admiral, you referred in your statement, on page 3, to reaching over and choosing package 3 from the shelf, launching it as a satellite, and recovering intelligence within an hour.

What do you refer to there as package 3?

Admiral HAYWARD. That is more of a philosophy. I feel very strongly, Mr. Chairman, that the time is going to come when we in the Navy or we in the United States, let us say, have to have the ability to put a small complex satellite into orbit from an airplane. In other words, there is no reason why one cannot. There are no physics laws that prohibit you from taking a solid rocket, flying it at 40,000 feet, and putting it in any orbit that you want, as far as polar or equatorial, and this would give you a tactical application.

For instance, if you just wanted to know one particular frequency spectrum, if you wanted to know one specific thing, let us say you wanted to cover southeast Asia to the north and you wanted some intelligence right then and there. This would give you flexibility in a tactical system. Everybody has referred to space as just a strategic thing. I feel that the ability to launch one of these from aircraft has lots of advantages, as you will see in our Pacific Missile Range where the only real good place in the United States exists to launch polar orbits, and this would give you the ability to launch a small satellite in any orbit you chose.

The CHAIRMAN. Do you have in mind, for instance, if your commander were out in the Indian Ocean and he wanted to know whether there was a mobilization of troops or equipment, he would do it by sending up a satellite?

Admiral HAYWARD. Not necessarily, no, sir. It would be a great tool for tactical intelligence. He might want to know what radar stations were on, he might want to know what communications were on at that particular time.

Now I will go into a bit of this in the classified section. We have a presentation in the classified field of this nature.

The CHAIRMAN. But to demonstrate the practical application; from an airplane, launched from a carrier, you could send up a missile in orbit to obtain very valuable intelligence within the hour for the fleet?

Admiral HAYWARD. That is right.

The CHAIRMAN. That is what you had in mind?

Admiral HAYWARD. That is exactly what I was thinking.

The CHAIRMAN. Now all through the hearing we have been discussing long-range missiles, ICBM's and others.

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. I notice there is no reference to it in your statement. Did you overlook reference to the use of that?

Admiral HAYWARD. No, sir. Of course our ICBM is the Polaris. We are firm believers in mobility. We do not want target U.S.A., we

want to put the target away from the United States, and it is the inevitability of a deterrent that is important.

If you have a system that is invulnerable to surprise attack and effective so it would be possible to be effective even if a man read in the New York Times we were attacked, and still destroy your enemy, this is the thing you are working for. Any system that basically depends on being able to defeat a surprise attack is a weak system, and I say this and repeat it all of the time: Any system completely vulnerable to a surprise attack is a weak one; deterrence should be inevitable. We need flexibility in our deterrent system.

It is what the Russian planner thinks, not what you or I think. If he thinks he is going to be destroyed no matter what he does, he is not going to start it. That is why if we go down this one line of the megawar, if we go down just one part instead of addressing the whole challenge, the whole complex spectrum, we are making a mistake for the United States. We can't afford to do this.

Now, when I did not make any mention of ICBM's, the Polaris to my way of thinking is an ICBM.

The CHAIRMAN. Well, now, what progress are you making which you can speak about in open session—what progress are you making in reference to the Polaris?

Admiral HAYWARD. Excellent progress, Mr. Chairman.

The CHAIRMAN. Is it operational at this time?

Admiral HAYWARD. No, sir; it is not operational at this time.

The CHAIRMAN. How close to operational is it?

Admiral HAYWARD. It will be operational in 1960.

The CHAIRMAN. In 1960?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. It is experimental now?

Admiral HAYWARD. It is in research and development now. We will give the committee in open session a complete rundown on the status of the Polaris program which is our part; this is the first system, Mr. Chairman, that the Navy has had in the deterrent business. This system is primarily a deterrent system. Any deterrent you get from the rest of the Navy, of course, is built in on the other side of the spectrum, and anything you get is a bonus in the general war. You must always remember that the Navy is peculiarly adapted to face the greater part of that challenge across the spectrum of war, from megawar down.

We make no bones, of course, or any hesitations or reservations, that the Strategic Air Command carries the great part of the deterrent force in the megawar part of the spectrum right today, but in that part of it you still have to have flexibility. You cannot just have one system. You cannot be dependent on just one way. Your system has to be inevitable, and it has to have flexibility, and it cannot be built just in fortress U.S.A.

The CHAIRMAN. Well, now who is going to give us that information about the Polaris?

Admiral HAYWARD. Admiral Raborn, who runs this entire program. Admiral Masterson will give you the general missiles, but Admiral Raborn will give you the complete briefing on that in the unclassified form and then we have some classified information on it.

I thought it would be best to have Admiral Masterson on the general situation first rather than the Polaris.

The CHAIRMAN. Mr. McCormack?

Mr. MCCORMACK. No questions.

The CHAIRMAN. Mr. Fulton?

Mr. FULTON. Admiral, we are glad to have you back again. It is always a pleasure to hear somebody who speaks explicitly and in simple English. You come right to the point. Might I refer back to your comment on the fact that the Vanguard will now possibly stay up 2,000 years. That really brings us into the space age with a tremendous start, because if we are looking to see who is ahead in the field of permanency on satellites, it would certainly mean that we with the Vanguard program have been eminently successful.

For example, with 31 million seconds in a year and if the Vanguard stays up 2,000 years, at 5 miles a second, that is 10,000 times 31 million, which is 310 billion miles that the Vanguard will have gone in 2,000 years with one puish, and that is a pretty good success, is it not?

Admiral HAYWARD. Yes, sir, that is the point that I want to make. People are too prone to see what happens on the launching pad and say failure or success.

Mr. FULTON. So really on distance with the Russian satellite now possibly in orbit, although nobody knows, around the sun, as far as distance is concerned we are doing a pretty good job of being ahead of them and being able to instrument it to show that we are right, is that not right?

Admiral HAYWARD. Yes, sir. If they had had our solar cells in theirs, theirs would still be broadcasting, but they do not have them.

Mr. FULTON. That solar battery we estimated would last 150 years. What is your estimate now?

Admiral HAYWARD. It may be more. We do not know. It will depend on how much of the meteorite dust it runs into. We have gotten tremendous value out of the Vanguard and, of course, the second stage of the Vanguard is the same stage that is used in your lunar probes.

Mr. FULTON. So actually then you would say that the Vanguard as a series of tests has been successful on the amount of scientific knowledge that it has relayed to us and the free world as well as the Russians, likewise on the distance because the Russians have not been able to compete on distance.

Admiral HAYWARD. Not that way; no, sir. This is a very stable orbit and we have learned a tremendous amount about the earth. The actual data we have gotten on the earth has been of tremendous scientific value.

Mr. FULTON. Likewise on the instrumentation of the Vanguard we are ahead of the Russians because they do not have the solar battery setup that we have—that is a continuous energy system that needs no repair?

Admiral HAYWARD. That is correct, and of course, as you know, the Vanguard program has been turned over to the National Aeronautics and Space Agency and they are going to continue with the Vanguard program. You know there are 512 separate functions that had to work in the Vanguard system to make it go. On the one that

we had the unfortunate explosion, 511 worked and a microswitch chattered for six-tenths of a microsecond and that was the end of it. That gives you an idea of the complexity of some of these things.

Mr. FULTON. The Army has one more moon shot to go in its program and then there remain two of the payloads that we could use the Thor-Able combination with for a moon shot. The question then comes up as to our programing, whether we should go for deep space probes, possibly Venus or Mars, just for distance, or should we say that strategy comes first in the cislunar area, this is between the moon and ourselves, where it is for our safety and security in the United States to know what it is and be strong. Generally on programing do you lean toward the strategic scientific research in the nearer area or do you think there is more to be gained from deep space probes at this time?

Admiral HAYWARD. Well, of course, I would answer that, Mr. Fulton, at this time, by saying that I have an awful lot of work to do in the state of the art in miniaturization: What will I accomplish with a deep space probe? Is it part of the psychological overall spectrum? If that outweighs other factors, you would go ahead to do it. But when we get to this pounds-in-orbit routine, admittedly, and I do not think anybody in the technical world would dispute it, the Russians have better rocket engines than we have. But has anybody ever looked as to why the Russians have better rocket engines than what we do in the United States. If you go back into Russian history, their Academy of Science, in 40 years—and I attribute a tremendous amount to the U.S.S.R. Academy of Science—they made basic technical decisions a long time ago and they decentralized their research and development. They have state of the art work. In other words, there is one man in Russia who has nothing to do but make the best rocket engines. That is all he does. He has a dual incentive. If he does not do it he gets shot. If he does, he gets lots of money and he is a wheel. But we have gone the other way. Look at the ICBM. The Academy of Science in Russia right after the war decided they were going to go the ballistic missile route. They did not wait for any breakthrough by any Atomic Energy Commission. They did not care whether they had 20 megatons or 20 tons yield. They were going to go the ballistic missile route.

Did they try to make a 5,500-mile system? Oh, no, they said, "We are going to make a ballistic missile that will be better than the V–2." They went to a 700-mile missile, but they went the ballistic missile route. The rocket engine people had the best rocket engine. They had their guidance people. Our approach has been the other way.

You get a big system. We are going to have an ICBM. We rushed around in 1954 after the Killian report, we are going to have an ICBM, we have to have it tomorrow. This is not the way you do things technically, and the state of the art is the thing that you get dividends in, and this is the hardest thing really in this business to ever get anybody to believe. When I go before people I have a glamorous system and it can be put all over the front page. But when I try to get something for a solar battery or try to get something for something else, then I have a real rough time. What the system has done is made congenital liars out of all people like myself to get my money. This is where the Russians in their state of the art development are

ahead of us. They are ahead of us in rocket engines, there is no question about it.

Mr. FULTON. I agree with you thoroughly and yesterday I was trying to build down the ICBM complex, that everything depends on our having an ICBM. Because it is only one of a number of weapons systems and if we put our sole security of the United States on one weapons system and have it outflanked we are done. I agree with you thoroughly.

I am almost finished with this. I will not take too much time. The Navy last year was proceeding with the development of the moon as a ready-made satellite for reflection and reconnaissance purpose. Will you comment shortly, if you can in open session, on the Navy's use of the moon for reconnaissance purposes and electronic processes in taking advantage of the process of ionic emission?

Admiral HAYWARD. I cannot in open session, no.

Mr. FULTON. Have you made progress in that field?

Admiral HAYWARD. "The witness stood mute."

The CHAIRMAN. Let us take that up in executive session.

Admiral HAYWARD. All right, sir.

Mr. FULTON. Do you have any evidence, that has been given to you as the Director of Navy Research and Development as to the Russian progress on ICBM's relative to the U.S. state of the art? If you do, we would like to hear about that.

Admiral HAYWARD. I would rather say that in closed session also.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Admiral Hayward, I am sorry that I could not hear the greater part of your testimony because I had to attend the organizational meeting of another committee, but from what little I heard, I sincerely want to compliment you. You spoke about the U.S.S.R. having an Academy of Science and that has been in existence for about 40 years; is that correct?

Admiral HAYWARD. Yes, it is older than that, actually, but I have traced it for 40 years in its operation.

Mr. ANFUSO. Isn't it a fact that the Rusisans have been fooling around with rockets since 1903 or somewhere thereabouts?

Admiral HAYWARD. Actually they have some very famous firsts in rockets. The rocket staging business was one of the Russian firsts. They have been very well inclined this way. They are good scientists.

Mr. ANFUSO. There is talk that they inherited a great number of scientists from the Germans. That is all very well. But nevertheless they are good scientists by themselves in their own right.

Admiral HAYWARD. Yes, sir.

If you look at the table of elements that you see on all physicists' walls, Mendeleeff, in 1857, was the man who put that together. I don't want to leave the impression all of the Russians are 12 feet tall. They put their pants on just like you and I do, and I think we can beat them.

Mr. ANFUSO. Admiral, I would like to ask you this question. You needn't answer in open session, but I would like to have an answer in closed session.

Assuming that you could look into a crystal ball and saw war with Soviet Russia by 1961 or 1962, and assuming further you were Commander in Chief of all of our Armed Forces, charged with defending

America and the free world, is there any program or programs now in progress or not even commenced that you would want to speed up or have advanced in order to assure victory for ourselves?

Admiral HAYWARD. I will answer that by saying we are at war now.

Mr. ANFUSO. That is the answer I would like to have you make.

Admiral HAYWARD. Only by hard work—we don't get across to our people that it is hard work. We can't get something for nothing. Whenever you look at this, you look and you say the ICBM. You will see a lot of people buy this because then you or I or somebody else won't have to lie in the mud or fight or die. If you are going to keep your freedom, you are going to have to fight and die for it. You are not going to have a simple way to do it, and there is no substitute for hard work. You are at war now, and it is the whole challenge that you have to face, and that challenge, you can look at the gross national product of Russia. It goes up. They produce more for less every year. And this is dangerous. Those curves will cross. If you just read what Khrushchev says and the rest of them, they are going to beat you at your own game. They are going to beat you the other way. They have made no bones about this. They are going to beat you technically. They are going to be better than you are, and we have to face to that.

Mr. ANFUSO. Russia has declared war upon us a long time ago, and I am afraid we have not conveyed that clearly to the American people. Isn't that correct?

Admiral HAYWARD. That is correct.

Mr. ANFUSO. I think we must do everything in our power to get the American people alerted to the point that they must realize that we are in a war, and that they must make sacrifices.

Admiral HAYWARD. That is all.

Mr. ANFUSO. All of us here in the Congress are willing to do the same thing, work day and night to protect this country, because we are at war; isn't that so?

Admiral HAYWARD. That is correct.

Mr. ANFUSO. And we should spare no effort in that respect.

Admiral HAYWARD. We should spare no effort.

Mr. ANFUSO. And we should do that at the expense of not balancing the budget.

Admiral HAYWARD. When you say balance the budget——

Mr. ANFUSO. I don't want to get you into any politics.

Admiral HAYWARD. Well, I will probably get fired anyway.

Mr. ANFUSO. Thank you very much, Admiral.

Mr. MCCORMACK. Will you yield to me?

Mr. ANFUSO. I certainly will.

Mr. MCCORMACK. In other words, to try to bring it to an understandable point, you can't deal with the Soviets on a moral level; is that right?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. You can't deal with them on the level of idealism; is that correct?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. The only level on which you can deal with them is the law of self-preservation?

Admiral HAYWARD. That is right.

Mr. MCCORMACK. You can't deny that the law of self-preservation applies to the Soviet Union and her people the same as it does to little Liberia or the people of the United States?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. Much as we dislike it, we had better be powerful and strong militarily, and that is the main vehicle through which our national objectives in the field of diplomacy are obtained. It is a broad statement. It could be broken down sometimes. But as long as they adhere to world revolution, we have to be constantly on our guard.

Admiral HAYWARD. That is correct, yes.

Mr. MCCORMACK. I didn't ask these question of you for my information. I have said this hundreds of times in and out of Congress, and I will continue to say it. But I was anxious to get your views for the record, because you, like all of us, are concerned not only with today but with these little youngsters walking around the street and wondering what kind of a world they are going to live in, and the answer is that it depends upon the leadership of today.

Admiral HAYWARD. That is correct, sir.

Mr. MCCORMACK. And the soundness of their judgment and their vision and courage to carry their judgment into operation.

Admiral HAYWARD. That is correct.

The CHAIRMAN. Mr. Bass.

Mr. BASS. Admiral, I would like to refer to the last sentence on page 3 of your statement, where you say "After a year of furious U.S. activity, I sincerely conclude that the U.S. supremacy in space science is threatened not by the lack of talent but by our skill in bureaucracy."

Would you mind enlarging on that?

Admiral HAYWARD. I would be delighted, sir.

I am sure when the staff draws you up that diagram, that the chairman asked for, you will see what I mean.

Now, if you go back over my testimony last year, I was with the Manhattan District of Engineers when we went into the atomic energy business. You saw how we went from the military side to the AEC today. Now, the AEC is a very successful agency, and what happened with the space law was that we have a military liaison committee, and one of the strong points of my testimony was that it had to be responsive to the military. But now let's take a look and you will see that you have NASA and ARPA, which is the Advanced Research Projects Agency, and then you have the Director of Research and Engineering in the Department of Defense. Personally—and I am now speaking from my own opinion—I am not speaking for my boss, Admiral Burke, because he would not agree with me. I feel we should have one U.S. space program.

I will give you an analogy. Suppose when the atom bomb was made we had put the AEC over here and said, "Now, look, you go look after the scientific nuclear physics side of it," and we said to the Department of Defense, "Look, boys, you look after the weapons side of it." What do you think would have happened? I do not believe that we would be where we are with the atom today, particularly from the weapons side. I felt—and as I repeat my testimony—really, I don't remember it verbatim—I felt that NASA should have been set

up similarly to the Atomic Energy Commission, with a division of military applications in this agency; that we should have one space program, and when we did this hard work that I am talking about, and we had the components and had a system, they said, "Look, boys, here is what we can do. If you want to make a weapons system out of it, this is the way." When they blow tests out there, they are not weapons, but they have a curve, and they say, "Look, for so many kilograms of this you can get so much bang." This is the way we can package it. When you look at our weapons today, this system has worked. As you will see in our presentation on the Pacific missile range, and the Atlantic missile range—now, the military get into it real well on the operational end of the business. I am convinced that something has to be done along this line in order to streamline and to get the best program for the United States. If you don't do that, how can you distinguish between military and science? It is indistinguishable. You are going to have a continual argument all of the time. Who does what to whom? In the atom business you never had that. You knew who had the responsibility. You knew how it was done. And the military got what we needed.

If you look through the history of your Atomic Energy Commission, you won't see—there is one example which I won't mention in open session, but you won't see where we haven't gotten what we wanted from the Atomic Energy Commisison.

Now, admittedly, the Joint Committee on Atomic Energy has been one of the strongest committees in the Congress. It has monitored the Commission's work, and it has done an outstanding job, and they are a part of our reason for success. I, Admiral Hayward, don't personally feel we can make a successful U.S. space program unless we have responsibility clearly spelled out and completely responsive to our military requirements. That is what I am interested in, not just the Navy or the Army or the Air Force, but the United States. I don't think you are going to get your money's worth.

Mr. ANFUSO. Would you yield to me at that point, sir?

Mr. BASS. Yes.

Mr. ANFUSO. In connection with that answer, I asked this question yesterday, and I would like to get your answer to it.

In connection with those research and development matters in space that represent dual purposes in that there may be developments for peaceful purposes or for military purposes, do you believe these should be financed and managed by NASA or jointly as to financing and management with the Defense Department?

Admiral HAYWARD. I will answer it this way:

I would have no fear of NASA managing that. If we have joint committee in Congress here on science and astronautics, I have a place I can go to, and I have a division of military applications. The military are right there, and it will work. The AEC works. Why won't that work?

Mr. BASS. In other words, Admiral, you feel there are too many different agencies having responsibility in this field and this ought to be centralized, our space program ought to be centralized?

Admiral HAYWARD. Space and aeronautics. You see, the NACA was our central aeronautical agency. There is not an airplane in the world that flies today that hasn't taken advantage of the research

and development work that they have done. The military had no problem with the NACA, and this worked, and was responsive. But as the setup is now, where you say the military is going down one street and the space agency goes another—and I am a great admirer of Mr. Glennan, and I am a great admirer of Roy Johnson, and it doesn't have anything to do with people. This is a government of laws, not people. But if you are going to set up a space agency, it should have been set up as the U.S. space agency, period.

The CHAIRMAN. Will the gentleman yield?

I was on the Armed Services Committee when that was discussed and also when we set up ARPA and, as I recall, there was strenuous opposition to putting all of this scientific effort under ARPA—all of the military scientific effort under ARPA. At that time the departments wanted to participate in the scientific effort.

Is it your idea now, that it would be better to turn the Navy portion over to ARPA and the Air Force portion over to ARPA?

Admiral HAYWARD. No, sir. You must remember, Mr. Chairman, that the research and development work that the services do has great application, not just to space, not just to aeronautics, but it has application to submarine, surface ships, to everything. We do our research and development work, and we have a tremendous job to do. I don't intend that this go to ARPA, and it shouldn't go to ARPA because you have to have the customer relationship; the man who is going to use the weapon has to be able to feed his ideas into it.

I say in the space business now—confining this just to space, not to the normal research and development programs, but the space situation—the reason is that you run into difficulty to try to distinguish between a scientific application and a military application; where you have two people trying to do it, this is difficult.

The CHAIRMAN. Well, I might say to the Admiral I also advanced the thought that we ought to have an atomic energy type of program, put it all together. But that was discarded by men who are experts on the subject, and apparently had given the matter a great deal of thought. They felt there were fundamental differences between the atomic energy and the space program, many of which you couldn't go into in a short period of time. But one thing was that the atomic energy program was set forth in the middle of a war when you could give dictatorial powers to one agency and tell that agency, "Regardless of what you need, take it and do the job." We ran into that problem.

Admiral HAYWARD. Mr. Chairman, the Atomic Energy Commission didn't come into being until January 1, 1947.

The CHAIRMAN. I mean the Manhattan District.

Admiral HAYWARD. Yes; Public Law 585 at that time is really an excellent example. I think you were on the right track at that time, and I think with events in the years to come you will see what I am referring to, Mr. Bass, I am sure.

Mr. BASS. Thank you, Admiral; that is all.

The CHAIRMAN. No further questions?

Mr. BASS. No further questions.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Admiral, on page 2 of your statement you stated—

Pounds in orbit have become a fetish that has led to several embarrassments. The only true objective would be the effectiveness of a satellite or an experiment and not the agency or the number of rocket casings loaded into space.

As you pointed out, there has been a great deal said concerning pounds of thrust and our ability to successfully orbit the sun, for example.

Many of us have been led to believe—and I think the public in general—that the No. 1 problem insofar as the so-called race with the Soviets is concerned, is in the rocket engine field.

Now, would you care to elaborate a little bit?

Admiral HAYWARD. As to the pounds in orbit, remember the little business of the Atlas here where somebody came out with a statement: "Well, they have a rocket casing on the payload, when you looked at the payload." But there is no doubt that the rocket business is the key problem to our space program. We don't have reliable rocket engines today. I don't know how reliable the Russians' are, because I don't know how many failures they have had. But reliability—just like when I go out to my jet airplane and I press the button, the turbine turns over, and I don't hesitate to go. I would be very loath to fly on one of our rocket engines today, because this is the No. 1 problem, and that is directly related to pounds in orbit. There is no question about it.

But, unfortunately—we, the United States—have certain launching vehicles now, the Atlas, the Titan, the Jupiter, the Thor, the Polaris, so you are wed to that particular rocket system.

Dr. Glennan has probably told you what the rocket developments are going to be. This is the key problem. I don't say that is isn't. But I want to emphasize just putting mere weight into space doesn't mean too much, because we are, with bated breath, looking for the scientific results from the Russian sputnik. What they really did, they had no hesitation to take our spectograph out of the Vanguard and use it in theirs. So this showed us a weakness. But it is the scientific object of the experiment that has been brushed under the rug.

What are you trying to do? What is the job? But I don't mean in any way to forget about the rocket problem, because you have to have a good rocket engine to do this. There is no question about it.

Mr. ANFUSO. What you are getting at, Admiral, is that we shouldn't just follow, we should have some new projects of our own that we can advance.

Admiral HAYWARD. Yes. You don't want always to react. You want to act. This is important.

Mr. ANFUSO. And you put it better than I.

Mr. MITCHELL. Admiral, something else that is extremely interesting to me, not in this statement, but when you were talking about the Soviet Academy of Science—and I think in response to questions by Mr. Anfuso—you pointed out that they were early leaders in rocket development; that there was no hesitation on their part—as you said, there is one man who has the sole responsibility for developing fine, improved rockets.

I gather by that that you feel that we are emphasizing too much the development of an entire system?

Admiral HAYWARD. That is correct.

Mr. MITCHELL. Rather than the component parts?

Admiral HAYWARD. That is correct.

Mr. MITCHELL. In that connection, let me ask you, Admiral, is there in your R. & D. establishment a component part of a system that you feel should be in the development stage, although it is not related to an entire proposed system?

Admiral HAYWARD. Well, let me tell you what happened when I took this over, over 2 years ago, now.

I immediately saw that we were not emphasizing this side of life. Now, my R. & D. budget is divided into two parts. Part I is the systems. Part II is the basic applied and supporting research, such as components, and that is 60 percent of my total budget, and if they cut me, and in my statement to the Secretary of Defense I said if I had to take a cut in this field, I would go back and just put all of my money in what I call the seed corn, because we have used up a tremendous amount of our basic knowledge. We have to go back to our basic work, and our developments of this nature, which are new, on phenomena, things that we haven't understood, and we can make steps ahead. So we in the Navy—and I have fought real hard to do it—have put our money into this. We have 1,500 contracts, for instance, with nonprofit organizations, universities, things of this sort, in basic research, which is part of the seed corn.

Mr. MITCHELL. Unrelated to any missile system?

Admiral HAYWARD. Unrelated to anything. These are the hardest things to justify. They say what application does it have to the Navy?

Mr. MITCHELL. When you come before the Congress, you don't know what the end result will be.

Admiral HAYWARD. I have no idea what the end result will be.

Mr. MITCHELL. Admiral, is that not one of the major handicaps we are undergoing now, insufficient funds for programs of that type?

Admiral HAYWARD. Yes, sir; it is.

Mr. ANFUSO. Would you yield there again?

Mr. MITCHELL. Yes.

Mr. ANFUSO. Admiral, were you cut in your estimate as to what you needed for your projects?

Admiral HAYWARD. Certainly.

Mr. ANFUSO. How much were you cut?

Admiral HAYWARD. Well, I can give you the rundown on what I asked for and what I finally got, which was roughtly, rather than to go through all of the figures on it, it is roughly what I had last year.

In the basic Navy R. & D. program this year, I have $522 million. I had $521 million or something like that, almost the same, last year.

Mr. ANFUSO. How much did you ask for?

Admiral HAYWARD. To give you a little rundown on this, because I am a program sponsor, and I fight anybody that wants money from some other place, as far as R. & D. is concerned. Originally, in looking on the true requirements, the true requirements that I submitted to my Chief of Naval Operations in the R. & D. program were $770,733,000.

Mr. ANFUSO. You were cut about $270 million, then?

Admiral HAYWARD. That is correct; yes.

Mr. ANFUSO. Now, if you had that $270 million, what would you do?

Admiral HAYWARD. In this part 2 program, for instance, this would make the difference: I would put $150.8 million in that part of the field. Now, the total part of the program—this regular program that I am telling you about is exclusive of the Polaris program, and it is also exclusive of the Pacific missile range, which will be presented to you. They will show you their figures.

Now, of course I realize that I am in competition with everybody else, and this is good. I am only a program sponsor. But I made the same statement that I made to you to the Secretary of Defense, that I do not believe that I have sufficient money to do the research and development work that the Navy needs.

Mr. ANFUSO. The additional money would have helped you to carry on your research in a faster manner, is that correct?

Admiral HAYWARD. That is right, and it would have helped me to cover fields that I am not covering now that I want to cover.

Mr. ANFUSO. Thank you.

Mr. FULTON. Would you yield a minute?

Mr. ANFUSO. Yes, surely.

Mr. FULTON. Actually, NASA can contract for you and help you on doing some of your basic research for the Navy, can it not?

The question is, Would you need separate facilities or can you get this money, which I would favor, and have one of the civilian agencies help you out on the basic science approach?

Admiral HAYWARD. Well, actually, Mr. Fulton, the facilities that NASA has are the three laboratories: Langley, Lewis, and Ames. A lot of ours would be in the basic, the university approach.

Mr. FULTON. So actually yours is not going into facilities but into contracts?

Admiral HAYWARD. And a lot of it would be in-house, to. I have some real fine scientists that work for the Navy, like Dr. MacLean, Dr. Kurie, and people of this kind that have made tremendous contributions. In other words, this money would be in the regular R. & D. program.

I had specific items that I had to discuss with the Secretary when I presented why I needed more money.

Mr. FULTON. But it is specifically in the operations field of R. & D. and not in the facilities field? You don't need additional facilities?

Admiral HAYWARD. No, it is not in the facilities field; no, sir. I have some items I need, but this money is the research and development program for the Navy.

The CHAIRMAN. Now, gentlemen, at this point I want to mention this. It is 20 minutes to 12. I talked to Mr. McCormack before he left, and he said we are going to have difficulty doing much work this afternoon in the committee because there are two bills coming up for vote.

Now, I don't want to cut anybody off, but my thought is this, if it is all right with you: I will ask anybody, from now on, who has any questions, to speak up; we don't want anybody cut off, and then we will try to finish with the admiral and go on through until the first bell.

We are going to have a rollcall rather soon, though. We will go on through to the first bell with the witnesses that we have, and come back during general debate and try to finish the executive session.

Now, we have carried over one witness already, and I would hesitate to carry over too many witnesses. But if we could hear the out-of-town witnesses first, Admiral——

Admiral HAYWARD. Mr. Chairman, we can come any time you want. I have them here. These are people in town, and you can take your time.

The CHAIRMAN. So in the event we don't finish, they will be available later on?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. It might be next week.

Admiral HAYWARD. That is perfectly all right, Mr. Chairman, any time.

Mr. MITCHELL. Mr. Chairman.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. The first bill coming up is one concerning another committee I am on. I will have to leave. I have one further question.

The CHAIRMAN. They are both important bills, and we will all want to be registered on the votes.

Mr. MITCHELL. I have one further question.

The CHAIRMAN. All right. And give these others a chance to be heard, too.

Mr. MITCHELL. Admiral, the majority leader in the colloquy with you, and which you agreed to, I believe, said the only way we can deal with the Soviet Union is under the law of self-preservation.

I am personally interested in that because I would like to be around for awhile, but I want to ask you in that connection, what do we need in the missile and rocket field besides, as you said, hard work and establishment of a single space program? Would you add to that a need for more money for basic research?

Admiral HAYWARD. Yes, I would.

Mr. MITCHELL. What else, other than those three things that you have very clearly pointed out?

Admiral HAYWARD. From the Navy's point of view, where we have to meet this whole thing, I will tell you what we need, of course, outside of this other:

A missile system that can be used and priced economically enough to make them useful in limited war, and not just all-out war, like surface to surface. This is a technical need.

You say is there anything lacking in my program outside of these two things. I can't say anything at the moment. I couldn't answer.

Mr. MITCHELL. That is all, Mr. Chairman.

The CHAIRMAN. Are there any further questions of this witness?

Mr. WOLF. Mr. Chairman.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Admiral, I am Leonard Wolf, of Iowa.

May I say, Admiral, I admire your courage in speaking out on this subject, and I hope you will continue to do so everywhere and every chance that you get. I think it is important.

I also say, as a man who served in the Navy, I love the idea of sending a man to space in a bucket of water. I have some academic ques-

tions, but I will not bore the committee with them. I think I will send them to you.

Admiral HAYWARD. Will you do that?

Mr. WOLF. But I would like to know if you can say in a word how you can overcome this heat factor. Is there a tendency that this man will be boiled alive?

Admiral HAYWARD. We feel we can lick the heat problem. It is still a problem. This is the envelope Crossfield has to worry about. If he is too high, he is too slow. If he is too low, he is too hot. Even with the Vanguard, exposed 2 weeks to direct sunlight, we haven't had this heat problem we were worried about. Out in space your density is greatly down. It is going through the atmosphere that you have the problem.

The CHAIRMAN. Any further questions?

Mr. HALL. I have one.

The CHAIRMAN. Mr. Hall.

Mr. HALL. Admiral, I am David Hall, of North Carolina.

You made the statement as to the unfortunate and unwarranted reaction to Vanguard. Would you expand briefly on that statement?

Admiral HAYWARD. Of course you know, I am sure, I have good friends in the press, but I got really upset when everything was labeled a failure. It is funny. Even today, in the press, it is always news when there is an argument or a difference of opinion, because if you read in the press you will see that Congress "debates" and the Supreme Court "deliberates," but we in the services always "bicker." I hope the press will take that as I meant it. That is the sort of thing, where the thing blows up in all its glory and everything is a failure: "The Vanguard Is a Failure."

Mr. HALL. And yet, the Vanguard is the only one that has been a complete success, so far?

Admiral HAYWARD. You are correct, Mr. Hall.

The CHAIRMAN. Any further questions?

Mr. DADDARIO. Although you say this work is being done by many laboratories, many agencies, and usually in great harmony, taking everything else you have said, both in the printed record here and in your off-the-cuff remarks, Admiral, am I correct in my assumption that you would prefer that you had not these many laboratories, many agencies, but an overall agency and that if we did have that, the job would be better done than it is being done now?

Admiral HAYWARD. No, sir. My real argument, of course—the working people, and I am talking about the working people like those pictures you saw, the Air Force, the Army, the Navy, the scientists, they work in very close harmony. Our only disagreement, as I said in my statement, is this bureaucracy. If you haven't been through this system—I have—in order to get a program, in order to get things through, it takes persistence, and there are many people who can say "No," and only a few people who can say "Yes." That is why.

What I am trying to get across is we want one, a U.S. space program, and this has got to be decided in Washington, really.

Mr. DADDARIO. And you would say that we should have one in the form of the AEC?

Admiral HAYWARD. That was my original testimony.

Mr. DADDARIO. Which was successful in accomplishing a great job that was put before it, and you think that is the kind of formula that would best meet this need?

Admiral HAYWARD. Yes, sir, this was my original testimony.

The CHAIRMAN. Any further questions?

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. Unfortunately, I had to be away earlier this morning, Admiral, but did you touch upon Navy air-to-missiles, Sidewinders, at all?

Admiral HAYWARD. No, sir, we haven't come to the missiles. Admiral Masterson will give you a rundown completely on all of our missiles.

Mr. MILLER. Who developed the Sidewinder?

Admiral HAYWARD. I know the Sidewinder very well. I was the experimental officer. But Dr. MacLean was the man who gets the "kudos" for the Sidewinder, and it was done in spite of the fact that people wanted to kill it. This was a system that was developed in—in 1946 and 1947 we were first looking into infrared at Inyokern, and Dr. MacLean was head of the aircraft fire control section there. He is now technical director, and incidentally, he is the only Government scientist I know of that has received this $25,000 award for scientific accomplishment.

Mr. MILLER. He works for the Government?

Admiral HAYWARD. Yes, sir.

Mr. MILLER. Not for some development company?

Admiral HAYWARD. No, sir, he does not.

Mr. MILLER. As I understand it, this is a Navy baby all of the way through.

Admiral HAYWARD. That is correct.

Mr. MILLER. Conceived and developed in the Navy.

Admiral HAYWARD. That is correct.

Mr. MILLER. It is the only thing that has been tested in war, and it might have had some effect as a deterrent in Quemoy.

Admiral HAYWARD. It was very impressive to the opposition.

Mr. MILLER. I like to say for my colleagues, we hear a lot about the arsenal complex, and whereas I have no objection to great scientific bodies, the development that takes place through a lot of private industry, that the Government pays for—I have been on committees that have investigated that. Don't kid yourself that we don't pay $1.50 for a dollar's worth there. But this was something that was done in this way.

Admiral HAYWARD. Yes, and they wanted to kill this. Its nearest competitor costs $10,000 in production. This costs $2,800.

Mr. MILLER. This cost $2,800. I will say I just came back from the Far East and no matter what the Chinese Communists tell you about why they decided to pull their stakes, it is a fact that six Sidewinders were fired. Three of them happened to be fired in salvo. They got one plane. The others were fired singly, and they each got a plane. So you can, so far, say you got a 100 percent hits out of them, is that right?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. If there are no further questions, we will now hear from Rear Adm. K. S. Masterson, USN., Director, Guided Missiles Division, OP–51.

Admiral Masterson.

Admiral MASTERSON. Mr. Chairman, gentlemen——

The CHAIRMAN. You have a prepared statement, and you may proceed.

STATEMENT OF REAR ADM. K. S. MASTERSON, DIRECTOR, GUIDED MISSILE DIVISION, OFFICE OF THE CHIEF OF NAVAL OPERATIONS

Admiral MASTERSON. I have a prepared statement, and with your indulgence, I will stick by the prepared statement. It may be easier for you to follow it.

The CHAIRMAN. Fine.

Admiral MASTERSON. The Navy guided missile program is based on two fundamental requirements:

1. To provide our air, surface, and submarine striking forces with an attack capability, independent of foreign real estate and changing international politics, employable in the face of strong enemy defenses, and adjustable to the situation that may confront us, whether it be cold, limited or all-out war.

2. To provide a fleet defense capability adequate to support naval operations in the face of strong enemy opposition.

A decade of expenditures and development effort have gone into the creation of the Navy's guided missile potential. That potential is now in hand. Our missiles do not place us in the pushbutton stage of warfare nor do they replace the manned aircraft. Our missiles, per se, represent no capability in themselves, but this capability lies in the operating forces, the ships, submarines and aircraft configured to employ missiles, and in the men trained to use them. It is important to remember that the Navy's mobile forces at sea are relatively invulnerable to the growing Russian ballistic missile force.

In view of the wide publicity which has been accorded certain aspects of the guided missile program during recent years, it is assumed that it is hardly necessary to elaborate upon the various broad categories of missile systems. However, it may not be redundant to mention briefly these categories, of which there are five.

1. Surface-to-air, in which the missiles are launched from land installations or ships against airborne targets.

2. Air-to-air, in which missiles are launched by one aircraft against another, or against a missile.

3. Air-to-surface, in which missiles are launched against targets on the ground or at sea.

4. Surface-to-surface, in which missiles are launched from land or ship against targets on land or at sea.

5. Underwater-to-underwater, missiles launched from submerged submarines against submarines.

Now, I have a slide here today as to the first missile, the Sidewinder. I am not sure the slide will be visible.

The CHAIRMAN. You had underwater-to-underwater in the form of the torpedo?

Admiral MASTERSON. Yes, but these underwater ones are a little different. They go up into the air and then down again. I am not discussing torpedoes here today.

Now, as to the Sidewinder, this missile is guided by an infrared or heat-seeking device. The missile seeks the target by homing on the heat emitted from the aircraft. It is a relatively inexpensive and reliable weapon, measuring 9 feet in length and weighing about 155 pounds. It is about the size of a well-fed man. The Sidewinder is designed for destroying high-performance enemy fighters and bombers from sea level to altitudes over 50,000 feet. The missile, which has very few moving parts, and no more electronic components than an ordinary radio, requires no specialized technical training to handle and assemble it effectively.

The missile is now the primary guided missile weapon used by aircraft squadrons in the 6th Fleet in the Mediterranean and the 7th Fleet in the Western Pacific.

There you have a view of the Sidewinder and the size of a man beside it. It is basically a defensive air-to-air weapon to augment protection of our men and ships at sea from attacks by enemy aircraft. It will also be employed in the air defense of the continental United States by the Navy and the Air Force.

The missile permits defending fighters to knock down the fastest enemy aircraft even when it is miles away.

Now, we have already mentioned that the Sidewinder was developed at NOTS, Inyokern, China Lake. Dr. MacLean is the primary inventor of it. The Philco Corp. and General Electric Corp. are now producing this fine weapon. They are assisted by American Car & Foundry, Eastman Kodak, and Bulova in other phases of the missile system.

The Sidewinder 1–C, an advanced model, is coming along in research and development. It will have improved performance over this one. It is fundamentally the same inexpensive air-to-air missile.

Mr. MCDONOUGH. Is the range classified information?

Admiral MASTERSON. The range is classified, yes, sir.

The CHAIRMAN. Will the Sidewinder be effective against missiles, even slow missiles?

Admiral MASTERSON. If it is emiting a heat source, it will be effective against it. That is, if it is coming through the air fast enough to radiate heat, it will be effective against it.

The CHAIRMAN. Can you use it against a ballistic missile?

Admiral MASTERSON. I am afraid you would have a hard time getting into position to use it against a ballistic missile. You would have to get pretty close.

The CHAIRMAN. You mean to launch it?

Admiral MASTERSON. That is correct.

The CHAIRMAN. It doesn't have the range to launch it early enough to get it into position?

Admiral HAYWARD. Where it could be applicable, Mr. Chairman, would be if you were at sea and a submarine was launching a ballistic missile, coming out of the sea. Yes, you could shoot it, because it has a very powerful heat source, and it would home right on it.

The CHAIRMAN. So you can use it against ballistic missiles?

Admiral HAYWARD. Yes.

Mr. McDonough. Is this a magnetic attraction?

Admiral Masterson. No, sir; it seeks a heat source, infrared. You can hold up a cigarette and this would seek right on it.

The Chairman. Knock the cigarette out of your hand?

Admiral Hayward. It has actually shot down a 5-inch rocket that was shot. It was too expensive to keep shooting drone aircraft down, so they used a 5-inch rocket, and the Sidewinder hit it.

Mr. Fulton. Could I compliment the Navy that we on Foreign Affairs Committee took a look at the Sidewinders and consider they won one of the decisive battles of the world. It will go down in history, some day, where the Formosa Chinese lost only one plane to the Chinese Communist losses of 31 planes. It made the Chinese Communists withdraw to retrain, so it has been the greatest loss of face the Chinese Communists have had to date, that one particular instrument.

Mr. Miller. If the gentleman will permit, I will say not only to retrain but they had to change some of their propaganda, too. They came up with "this wasn't human, unnatural, and should not be used in warfare."

The Chairman. Will you proceed, Admiral, with your statement?

Admiral Masterson. I will show a slide of the Sparrow III. That is the next missile.

That is also an air-to-air missile, developed by the Raytheon Manufacturing Co., of Boston, Mass.

It has replaced its predecessor, Sparrow I in the fleet air defense.

This missile is about 12 feet long, weighs about 350 pounds, and attains a speed of over 1,500 miles per hour seconds after launching.

It is an all-weather missile, which can be fired through clouds or rain, in any kind of weather, from any direction.

Navy fighters can carry two to four of these Sparrow III missiles, and it will be the primary weapon for many present and all future all-weather fighters.

Now, Sparrow III is manufactured by the Raytheon Manufacturing Co., Lowell, Mass. Some of the planes will carry Sparrow III and Sidewinder missiles, but, as you know, a heat-seeking missile like the Sidewinder cannot fire through clouds.

The Chairman. You leave off the range. Did you do that intentionally?

Admiral Masterson. Yes; I will cover that in classified session, if you care to have that later on. These are sizable ranges.

The Chairman. Now, the Eagle is your next one there.

Admiral Masterson. The Eagle is a longer range system that I will cover in classified session, but it will have much longer range than either of these other two missiles.

Now, in the air-to-surface missiles, we have two of them, the Bullpup and the Corvus.

The Bullpup will show here. It is going into service this year. It is a tactical guided missile, designed for use by carrier-based Navy aircraft and shore-based Marine planes. It is for close air support of troops. It is 11 feet long, weighs 540 pounds, and is now in production at the Martin Co. It is a relatively inexpensive, highly accurate, and simple weapon. It too can be maintained on board ship by the normal shipboard personnel, just like all of our missiles. All of

our missiles have to be designed to where shipboard personnel can keep them up, as you know, because we can't take the scientists to sea with us.

It is particularly useful against comparatively small targets like pillboxes, tanks, truck convoys, bridges, anything that you can see from the air you can hit with this missile.

Mr. McDonough. What kind of launching apparatus do you use?

Admiral Masterson. It is launched from an airplane, from a regular pylon.

Mr. McDonough. Do you launch them from the ships' decks?

Admiral Masterson. No, sir.

Mr. McDonough. How about either of the other two?

Admiral Masterson. No, sir; not on either of those yet.

The Chairman. There is no homing device on this?

Admiral Masterson. No; it is launched and controlled from an airplane.

Mr. Hall. That is a solid-propellant missile. Are the others liquid-propellant missiles?

Admiral Masterson. Both of them have solid propellant at this time.

Now, the Corvus is an air-to-surface missile for use in penetrating heavily defended areas, and it is also for use against surface ships. It is designed of a size to permit its use on carrier-based aircraft, although it is a fairly large weapon.

The prime contractor for this liquid-fuel rocket is the Temco Aircraft Corp., Dallas, Tex.

The principal subcontractors are Reaction Motors, Inc., Denville, N.J., for the propulsion component; Texas Instrument Co., Dallas, Tex., for the guidance component; and W. L. Maxson Corp., New York, N.Y., for the guidance component.

Mr. Fulton. That is a hypergolic fuel.

Admiral Masterson. What is that?

Mr. Fulton. A type of fuel that when you put the two elements together it ignites on its own contact, it is not using air at all.

Admiral Masterson. That is right. When they mix they burn.

That is right. In the surface-to-air missiles, we have three. The Terrier is an all-weather surface-to-air missile. Designed to intercept enemy aircraft at longer range and higher altitudes than conventional antiaircraft guns, the 15-foot weapon weighs about 1.5 tons, has a range of about 10 miles, and utilizes a solid-fuel rocket motor. It employs beam-riding guidance. It rides a beam right on out. The missile is suitable for shipboard use or beachhead operations with the Marine Corps.

Shipboard Terriers are selected automatically from the magazine and loaded on the launcher which is then automatically trained, elevated, and fired. The entire operation takes only seconds. Radar then guides Terrier to the target.

The following ships currently in commission have Terrier-missile capability: two guided-missile cruisers, and one guided-missile destroyer. Under the present shipbuilding programs, the following additional ships will have Terrier-missile capability: 2 *Forrestal* class carriers, 3 guided-missile cruisers, 1 nuclear-powered guided-missile cruiser, 19 guided-missile frigates, 1 nuclear-powered guided-missile frigate, and 1 nuclear-powered aircraft carrier.

Terrier is the result of 8 years of research and development by the Applied Physics Laboratory of Johns Hopkins University, Silver Spring, Md., under the direction of the Bureau of Ordnance. This is a contractor-operated scientific organization run on a nonprofit basis by Johns Hopkins.

Now, the production is at the Naval Industrial Reserve Ordnance Plant, Pomona, Calif., by Convair. Other concerns which helped perfect Terrier are the Hicks Corp., Boston, Mass.; Bell Telephone Laboratories, Whippany, N.J.; Vitro Laboratories, Silver Spring, Md.; Reeves Instrument Co., New York, N.Y.; Ford Instrument Co., Long Island City, N.Y.; and the Radio Corp. of America.

Advanced Terrier: The advanced Terrier is intended for the same surface-to-air requirements as noted for Terrier above. However, the advanced Terrier will incorporate improved guidance features and will provide substantial improvements in coverage over the original Terriers. The advanced Terrier will also be made by Convair at the Naval Industrial Reserve Ordnance Plant, Pomona, Calif. It is in production right now and will be going into the fleet shortly.

Mr. FULTON. How many Terriers do you use at once. I was on the cruiser *Boston* and they used two at once to knock a plane down.

Admiral MASTERSON. That is a standard doctrine, to use two to give you close to a hundred percent chance for a kill.

Mr. FULTON. It is actually a twin rocket, two go off, one following the other.

Admiral MASTERSON. That is right.

The CHAIRMAN. What do these cost, Admiral?

Mr. FULTON. $40,000 a piece.

Admiral MASTERSON. The ones on the *Boston* were $40,000 a piece.

The CHAIRMAN. All right.

Admiral MASTERSON. I had command of the *Boston*, sir. Now, the Talos is the next surface-to-air missile. This is a bigger baby than the Terrier. It is now at sea on the *Galveston*. It is a surface-to-air missile powered by ramjet motor. It is launched first with a solid booster, which falls away, and then this ramjet 40,000 horsepower motor takes it on to its target. It weighs about 3,000 pounds, is about 20 feet long, 30 inches in diameter. It can destroy enemy aircraft at extremely high altitudes, and its range is beyond 65 miles. It has a different type of guidance from the Terrier. It has what we call a mechanical brain with input from the ship and the target. When it is within lethal range, a proximity fuze detonates the warhead. It can carry either high explosive or nuclear warheads.

Now, as I say, we have one Talos guided-missile cruiser at sea now, the *Galveston*. We have one nuclear-powered, guided-missile cruiser and five other guided-missile cruisers in the program to carry this weapon.

Bendix Aviation Corp. is the prime contractor for manufacturing this. As I explained earlier, the Applied Physics Laboratory is the main design and development laboratory.

Flight testing is conducted at the White Sands Proving Ground, which is one of the three national ranges. The Tartar is the next of our surface-to-air missiles. That is the baby of the lot. It is virtually the missile part of the Terrier system with some minor changes.

It is an all-weather surface-to-air missile designed especially for use aboard destroyers. It fits in a compact installation that fits in the small spaces associated with destroyers. It has about the same range as the earlier Terrier but not, of course, up to the ranges of the advanced Terrier.

It is a solid propellent missile being built by the Convair Division of General Dynamics Corp. in the same plant with the Terrier missile. It uses about 85 percent common parts with the Terrier.

Under the present shipbuilding program we will have three guided-missile cruisers using Tartar as secondary batteries and 18 guided missile destroyers using Tartar as their primary battery.

The Regulus I is our next missile. It is a surface-to-surface missile. As you see, it looks somewhat like a jet aircraft. This was the first operational attack missile to join the fleet. It resembles a modern swept-wing jet fighter. It is about 30 feet long. Its range is about 500 miles and it travels at high subsonic speeds. It is capable of carrying a nuclear warhead and it is powered by a turbojet engine. It is also guided by an electronic "brain," we call it.

Regulus I launching equipment can be installed in a short time on almost any type ship. Right now we are employing the Regulus I from submarines and from cruisers. We have four submarines now equipped to carry it, with another one coming along. It was developed by Chance Vought Aircraft Co. under a Bureau of Aeronautics contract. Final deliveries of this weapon have been completed. We have a fairly good inventory on hand.

In the underwater-to-underwater missile, the Subroc, we do not have a picture of that. It looks like a torpedo. It is fired out of a conventional torpedo tube. It can be fired underwater or on the surface of the water. It flies up in the air like a ballistic missile and then goes underwater to find a submarine. It is under development at the Naval Ordnance Laboratory at White Oak, Silver Spring, Md.

Goodyear Aircraft Corp. has the commercial contract to work with the Naval Ordnance Laboratory on the development of the missile.

Now we believe the Navy has a well-balanced, well-rounded missile program. It will increase the Navy's striking and staying power in any type of war. We know what objectives and requirements have to be met. The time scale for phasing new weapons into the fleet has not always been broad enough. As you realize, we have to get the ships out there and the planes out there configured for these before we can deploy the missiles, and this goes across the board throughout the Navy—the effort to get missiles in the fleet.

Developing and producing missiles is one thing, and operating them is another. New concepts of tactics, training, logistics, maintenance, and many other factors make the guided missile program a complex one. We believe the Navy can successfully, as we have in the past, continue to coordinate all of these factors directed toward a missilized nuclear-powered Navy of the future. Our efforts are directed to that end.

Now the Polaris missile also is a part of the overall missile program of the Navy. Admiral Raborn is in charge of that entire project and he will cover the Polaris later on. I have left that out of my presentation.

The CHAIRMAN. Thank you very much, Admiral. Now the bell has rung for a quorum. We will adjourn now until 2:30, if that is all right with the Navy, and, of course, if there is a vote immediately at 2:30, the members will return here right after the vote.

Admiral HAYWARD. All right, sir; we will be at your disposal.

The CHAIRMAN. I want to ask all of the newer members of the committee and the Congress to return here. Some of this has been reviewed before, but it is all vital for you people who are new on the committee to be here if you possibly can, as well as the old members. We want the old members, too.

We will adjourn until 2:30.

(Whereupon, at 12:15 p.m., the committee recessed, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION

The committee met at 2:30 p.m., in open session in room 356, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

Now we are in session and of course our attendance is going to be reduced this afternoon, unfortunately, but we have no alternative and, as we proceed, we may be caught with votes later on.

We have a brilliant statement coming up from Admiral Raborn. I wish everybody were here to hear him, but we have a copy of it and I will see that the other members get a copy and will induce those that have not been able to get over here this afternoon to go through it very carefully.

Mr. FULTON. I wish you would have the record show "another brilliant statement."

The CHAIRMAN. Yes, add the word "another."

Admiral HAYWARD. At any time the committee wants to get the full Polaris presentation, and I recommend very strongly that the committee get Admiral Raborn's full presentation at your convenience, I am sure Admiral Raborn would be delighted to give it to you, because I feel they should have it.

The CHAIRMAN. The full presentation, not the presentation this afternoon.

Admiral HAYWARD. No, sir; this is the classified and all of it. I think this committee should listen to the whole thing classified.

Mr. FULTON. Admiral, could I ask you if we could go down to Admiral Raborn's shop and do that, the Navy Building?

Admiral HAYWARD. That is the best place to do it, Mr. Fulton. I think this committee should do it. Other committees of Congress have done it and I feel to really know about it you should do this.

The CHAIRMAN. Well, this is a hard-working committee and we will have to undertake that.

Admiral HAYWARD. Did you want to ask any questions?

The CHAIRMAN. Admiral Masterson was still testifying at the close of this morning's session. There was one thing that I wanted to ask you, Admiral, which was referred to at one point.

I would like to ask you if it was in your statement or in Admiral Hayward's statement? I suppose it was in Admiral Hayward's statement. It was in reference to the threat from Russia regarding the missile program.

Admiral MASTERSON. It might have been on page 1 of my statement:

> It is important to remember that the Navy's mobile forces at sea are relatively invulnerable to the growing Russian ballistic missile force.

The CHAIRMAN. Yes. Now that is true, is it; that they are not vulnerable?

Admiral MASTERSON. Let us put it in this way, sir: We have not figured out how to hit a moving target with a ballistic missile yet.

Admiral HAYWARD. The reason for this, Mr. Chairman, is that the basic guidance systems of all the ballistic missiles are using the same fundamental principle known as the Shuler pendulum which has to do with inertial systems. You may have heard it referred to as the 84-minute pendulum. Now a ballistic missile uses this as guidance, which means if a ballistic missile leaves from a point A to hit point B it has to know where it is and where it is going.

Now all of the systems, no matter who comes before the committee—all of the ballistic missile systems, the Atlas, the Titan, and Polaris, the Minuteman, all of them use a guidance system based on the 84-minute pendulum. They are no better than the state of the art as I stated this morning.

So if somebody says their missile will hit somebody in the head at 0.5 nautical mile CEP and the other one will do this, it is generally known in the physical world and in the scientific world that inertial guidance has roughly the same characteristics for accuracy, so the the mobile system at sea is pretty hard to pinpoint from a ballistic missile, even if it moves only 2 miles or 3 miles under this system. Roughly the way a ballistic missile works, and I am sure you have probably heard it, when a ballistic missile leaves the pad and you are going from—let us say we are going from Washington to a target. What it does is this: You have a program in the missile. You have calculated mathematically the trajectory that this missile has to fly to hit that particular point. You compare this program of the missile against where the missile actually is.

As the missile goes up, and it has to pass through a point in space, X, Y, and Z, in time versus velocity to hit that particular point. Now if the missile is off, the programer says "Look, you are to the left, boy, come to the right," and once the cutoff is made at that particular point in space, there is nothing you can do about it, it will go there.

Now this is a fundamental thing that you have to know where "there" is and you have know where you are. And so the mobile base, the submarine, or the ship that is moving does not lend itself at all to this type of guidance system. So this is why from a ballistic missile point of view the Navy at sea is practically invulnerable to it.

The CHAIRMAN. There is not a homing device on the ballistic missile?

Admiral HAYWARD. No. The reason you cannot is the velocity is so great when you are coming back into the atmosphere whether it is an IRBM at 1,500 nautical miles or an ICBM at 5,500 nautical miles, it is the difference between mach 15, 15 times the speed of sound, and mach

25, and you are not about to control anything at this speed in the atmosphere. It burns up. So it is a free-flying object. Now from a technical point of view, I would love to see the day when we could do something about it. It is not here now and will not be for some years, but I wanted to emphasize this point that Admiral Masterson made as to why we felt that the mobile system was hard to hit with a ballistic missile.

Admiral MASTERSON. There is one other point in there, too. Hour to hour and even day by day the enemy does not know exactly where those ships are, so they do not even know what inputs to put into the missile, even if the ship were stationary on the ocean.

Mr. FULTON. Then could we say this: While each of the Atlas, the Titan, the Minuteman, and the Polaris have the same kind of ballistic missile guidance system, nevertheless the Polaris, because of its mobility, has the added advantage that another ballistic cannot hit it because it can move?

Admiral HAYWARD. That is correct.

Mr. FULTON. Where the Atlas, Titan, and Minuteman, once it has been programed in advance and they are tied to their location, are vulnerable to another ballistic missile.

Admiral HAYWARD. That is correct.

Mr. FULTON. So while there is the defect in the Polaris of not being able to hit a movable object, nevertheless the fact that it is on a movable base does make it a preferable weapon; is that right?

Admiral HAYWARD. That is right.

Admiral MASTERSON. That is correct. And there is another factor in there. In any fixed base system you have to either keep increasing the number of bases or the number of missiles as the case may be with time or your effectiveness goes down with time on a fixed base.

Mr. FULTON. And with the Polaris there is no need of invading any territorial waters or any territory of another country whether it is enemy or neutral or an ally of the United States?

Admiral MASTERSON. That is absolutely true, sir. These operate from the high seas.

Mr. FULTON. Could I just finish on one more thing now. On ships where we get these large type missiles that have liquid propellants, it becomes almost impossible because of the danger of handling, they are too hard to handle and stow. Is that not the case?

Admiral HAYWARD. Yes, sir, Mr. Fulton. The Navy, since we have been in the rocket business, we have been solid-propellant people.

Mr. FULTON. That is right.

Admiral HAYWARD. At the close of World War II we were making $100 million a month worth of solid rockets. We believe in the solid rocket. We have always believed in the solid rocket.

People now who come and sell you the solid rocket are buying exactly some of the basic research we did on Polymers Monomers back in 1946 and 1947. The reason we have to do this is we have to live with our missile. We sleep alongside of it. It is aboard ship. You cannot have a liquid fuel. This is where our great difference in environment occurs.

Mr. FULTON. So where there has been testimony yesterday on the possible mobility of the Atlas, Titan, or Minuteman, at sea (there would have to be carriage to get mobility on a ship or on a plane)

you come into the same difficulties—the size, and the handling of the liquid fuel. Even ashore, where we have small countries with old-fashioned roads, it just becomes impossible to handle a missile of that size with that kind of fuel.

So it does become permanently stationed where it is; is that not right?

Admiral MASTERSON. I would say it is an impossible problem unless you leave it in one place, on these big missiles.

Mr. FULTON. I agree. Thank you.

The CHAIRMAN. That is the reason they put them in wells, to make them less vulnerable?

Admiral HAYWARD. That is true, Mr. Chairman. Of course, in looking at the wells, and this is a good approach to it, the one thing that Mr. Fulton didn't cover was the reaction time. You see, when you look at the countdown of some of the large liquid missiles, if your system is based on the surprise motive, as I told you before, it is a weak system, and particularly the reaction time in solids is so much better. Of course, we in the Navy don't say that Polaris is the only thing that the United States should do. What we say is that the other deterrent systems that are proposed and are built should pay the same price of entry that the Polaris system pays, which is that it is relatively invulnerable, it is an effective system, and it is under U.S. control.

Now, we feel that the United States should not go down just one path, and that is why you cannot just go down the SAC path, or just the Atlas or the Titan or the Polaris path. You have to have flexibility in this entire spectrum of the war that faces you. This is what the Polaris gives you, and this is our contribution to the national deterrent.

Mr. FULTON. How many Polaris-type missiles and submarines did you recommend in the budget for the current and coming fiscal year that you did not receive funds for on the budget level?

Admiral HAYWARD. Well, Mr. Fulton, I know I can't take the fifth amendment on this at all. I would rather have Admiral Raborn present the Polaris thing before you ask that question because it would make more sense.

The CHAIRMAN. Well, let's proceed.

Mr. FULTON. How many more do you want? I would like to hear that.

Admiral HAYWARD. Mr. Fulton, to give you the background, the Navy last year went forward from the Secretary of the Navy to the Secretary of Defense for nine submarines and one tender. Actually, we were allowed a total—to begin with, we were allowed only three, and then finally five. Congress gave us the money for the nine submarines, as you probably know, and you probably know the executive branch of the Government said that they weren't going to expend this money.

Now, as you know, there are four very important terms in this town, and in my business you learn them rapidly. One of them is "appropriations," one of them is "obligations," "apportionment," and "expenditures," and in this particular field we didn't get the money, naturally, as the executive department of the Government said they wouldn't expend it. But we haven't gone forward with that program.

Now, if you are referring to the 1960 budget, I would much rather have Admiral Raborn answer that.

The CHAIRMAN. Well, how much money, Admiral, has been withheld from you, from use after we have appropriated it?

Admiral HAYWARD. I can give you that exact figure. I would rather give it to you from the record than from my memory, Mr. Chairman.

The CHAIRMAN. We would like to have it for the record.

Admiral HAYWARD. All right, sir.

(The requested information is as follows:)

DEPARTMENT OF THE NAVY,
OFFICE OF THE SECRETARY,
OFFICE OF LEGISLATIVE LIAISON,
Washington, D.C., February 19, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics, House of Representatives, Washington, D.C.

MY DEAR MR. CHAIRMAN: The following information is provided for the February 4 hearing. Figures are in millions.

(*a*) Fiscal year 1959 submissions for Polaris program:

Shipbuilding and construction, Navy (for 4 Polaris submarines Nos. 1, 2, and 3, and for construction of Nos. 4 and 5)	$252.1
Research and development, Navy	210.8
Procurement of ordnance and ammunition, Navy	253.5
Ships and facilities, Navy	5.2
Servicewide operations, Navy	5.5
Military construction, Navy	52.5
Total	779.6

(*b*) Congressional add-on:

Shipbuilding and construction, Navy (for 4 Polaris submarines (Nos. 6 through 9) and 1 submarine tender conversion	492.6
Research and development, Navy	71.2
Procurement of ordnance and ammunition, Navy	43.7
Servicewide operations, Navy	1.5
Total	609.0
Grand total for Polaris program	1,388.6

(*c*) The entire 609M congressional add-on was initially held in reserve by executive department action. By subsequent action, all funds have been released except 300.3M for Polaris submarines Nos. 7, 8, and 9.

Sincerely yours,

R. L. KIBBE,
Captain, USN, Deputy Chief of Legislative Liaison.

The CHAIRMAN. If you would also give us any statement as to the reason why it was withheld after it was given you.

Admiral HAYWARD. Yes, sir. We can give that for the record. When Admiral Raborn presents it, he will show you exactly the status.

The CHAIRMAN. All right; we will let the admiral proceed.

Admiral HAYWARD. Do you have any further questions for Admiral Masterson at this time?

Mr. FULTON. One more:

On the Regulus, why was that discontinued?

Admiral HAYWARD. The Regulus II, you are talking about, which is the best air-breathing missile in the world.

I was asked this question. It was turned down for money reasons, not technical reasons. This is a good missile, and technically the program is sound, but from the Navy point of view, and my boss, Admiral Burke, is faced with the possibility of having to go to war tomorrow or the next day, and he had a hard decision to make. We had placed our bets on Polaris. We think Polaris is the best weapons system in the country today. We had a hard choice from a budgetary point of view. It was cut out from the budget and not for a technical reason, Mr. Fulton.

Mr. FULTON. When the Regulus requires very little changing over of ships, and the Polaris, of course, has to have an operable Polaris submarine, we will call it, why isn't there a need for the Regulus as an interim missile in the Navy weapons system? Are we leaving a hole in there?

Admiral HAYWARD. I will quote my answer to Mr. McElroy on that, Mr. Fulton.

If the Regulus II is dropped and anything happens to the Polaris, you will have no missile really from a submarine.

Mr. FULTON. That is my point. Where we have one that has been in tests and well along, so that it is really a missile that we could depend on, I have seen the Regulus I shot from the cruiser *Macon*, off Guantanamo Bay last year.

Admiral HAYWARD. I am sure you realize how hard these decisions are.

As a technical person, in my position I don't make them. I sponsor the program, and the people who have the overall responsibility and the authority make those.

However, I have a good saying that I always tell them, which is that the technical answer or the technical policy might not be the best answer, but the man who makes policy should know the best technical answer, and I feel we gave them the best technical answer.

I can't answer for what decision was made after that.

Mr. FULTON. With the chairman's permission, may I read from House Resolution 580 of the House of Representatives? Unanimously, July 1, 1959—it is the jurisdiction of this committee which will be a surprise to some people, and I would like the military especially to know of the jurisdiction of this committee.

> Under rule 11 of the House rules, it is further amended, by inserting after clause 16, the following:
> "17. Committee on Science and Astronautics,"

and under paragraph f of that rule 11, there is this specific provision:

> Outer space, including exploration and control thereof.

That means that the control of outer space and that jurisdiction is under this committee, so that we are interested not only in civilian science but we are interested in helping you people in the armed services in the strategic areas, seeing that we either have the power to control or the power to prevent any other group from having it or any other individual nation to our disadvantage.

You see, so far we have been talking as if this is a civilian committee alone. As a matter of fact, it is much broader when we get to space, because we are interested in how the various services implement their approach to space.

The CHAIRMAN. I would like to say this on behalf of the gentleman, I don't think he ought to limit his statement to space. The jurisdiction of the committee extends, regardless, through all points of science and scientific support, whether it be military or civilian, and likewise in space, whether it be military or civilian.

Admiral HAYWARD. The man who did this, who put science before the head of this committee, was the smartest man for my money, because this covers everything, as the chairman has pointed out. This is the key to it, not only to space, but to an awful lot of the rest of the challenge.

This morning I didn't have an opportunity to tell you part of what science does, and what research does for your country for a reasonable sum of dollars in the cold war.

Now, we have an outfit known as the Naval Research Medical Unit No. 3, in Cairo, Egypt. This particular thing took over a 1,500-bed hospital in 1946. The Navy subsidized it. We support it.

The captain of that unit, Captain Seal, he talks to Mr. Nasser, he talks to the second man in government, he talks to everybody in the Government of Egypt. Even after they threw out the point 4 program, even after they wouldn't talk to the Ambassador or the attachés, my Captain Seal talks to Mr. Nasser and talks to the rest of them.

This particular work we have done in medicine research there, which the Navy has supported in all of the blood parasitic diseases, in all of the tsetse fly and malaria work, we have the best relations there. That costs $265,000 a year. A lot of people want me to stop it. They say, "What is the Navy doing in this business?" This is part of the broad spectrum of science, as the chairman points out.

You must never forget, Mr. Fulton, when you direct yourself to the science part of it, you cover all of it, not just space.

Mr. FULTON. I am accepting your statement, and the chairman's, on science, but I am saying under paragraph (f), where outer space is concerned, we have the jurisdiction, and the duty to explore, to send the new Columbus out under this committee and under policies set by it. Secondly, as if it were Germany in World War II, if we decide the moon is a security annex to the United States of America, this committee runs the people on the moon. That is the difference.

You see, we have the science of getting to the moon and the science generally, as the chairman and you both point out, from the center of the earth through every liquid, on up in the atmosphere. But likewise we have another thing that is very peculiar in this committee, and that is we are to run space, we are to administer it, and there is where we are interested in the armed services in space, as to how you run it, not just how you enter it.

The CHAIRMAN. Let me say this. It is 3 o'clock. We are going to have two votes over there. We want to proceed to hear Admiral Raborn.

Admiral HAYWARD. This is Admiral Raborn, head of our Special Projects, who runs the Polaris program, and I will turn it over to Admiral Raborn.

The CHAIRMAN. Go ahead, Admiral.

STATEMENT OF REAR ADM. W. F. RABORN, DIRECTOR, SPECIAL PROJECTS OFFICE, DEPARTMENT OF THE NAVY

Admiral RABORN. Mr. Chairman, I am delighted to be here to address the distinguished members of this committee.

I have a rather lengthy statement, and if it pleases the chairman, I would like to request that it be inserted in the record, and I would like to brief it down verbally for you, and you can cut me off where you want.

The CHAIRMAN. Just proceed, sir. We are running against time.

Admiral RABORN. Thank you, sir.

I have an unclassified dissertation, and I have a classified briefing which I am prepared to give at your wish.

Briefly, sir, the Navy, capitalizing on the long competence in solid propellants over a period of years, which you have heard a little bit about this afternoon, which gave the world and this country rockets, for full name, was a bold strikeout in the ballistic missile field, in solid-propellant motor developments, while the rest of the national effort was being channeled into the liquid-fuel path.

I am very happy to say that this courage which we showed has paid off and paid off handsomely.

Since the Polaris program was approved in March of 1956, as a formal effort, we have been able to develop large solid-propellant motors of adequate power and adequate stability, and the adequate measures for controlling, something that we did not know how to do, how to control precise termination of thrust and precise control of direction of flight, we have proven this to our great satisfaction, both by static tests and flight tests.

I am happy to say the rest of the weapons system for which I am responsible has kept pace. As you know, my responsibility carries into the building of the submarine. The Chief of the Bureau of Ships has said in his own gracious way he is a subcontractor to me. I have to select and train the crew, and the production facilities as well as the ashore and afloat maintenance facilities. All of this program, because I am a weapons system manager, we have been able to keep in step, one with the other, and I would like to report to this committee that I have had adequate funds for the program which has been approved.

My developmental funds across the board have been ample for the purpose for which we are trying to carry out this project. We are just getting into full-scale flight testing of our missile, itself. We are doing component testing, and the successes which we are having componentwise in these flight tests have been very reassuring to us.

We expect in the very near future to get into flight testing for range, which we haven't yet tried for, and I am confident we will meet the readiness dates for the submarine, which, as you know, Mr. McElroy has said this system will be operational in 1960.

We in the Navy are firmly convinced this weapons system offers a tremendous potential as to the deterrent capabilities of our country, for the reasons you have heard here, the relative invulnerability, chiefly because the launching sites will occupy many thousand cubic miles water, all friendly waters, NATO-controlled, not habitually flown over nor traversed by the surface ships or aircraft of the Soviets.

In addition to this, of course, the shores that are washed by these

waters are not available to the Soviets for shore detection devices, which could conceivably be erected for the detection of surface craft and submarines.

I believe, sir, this just about completes what I can say in an unclassified version.

Mr. ANFUSO. May I ask a question, Mr. Chairman?

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. You said this is rather friendly waters. Does that mean Russian submarines are not in those waters, like the Adriatic and Mediterranean?

Admiral RABORN. No, sir; it does not mean that at all. However, it does mean that the shores that surround those waters are friendly and in effect you do not see the Soviet Navy nor aircraft with any degree of frequency in those waters.

Mr. ANFUSO. Thank you.

Mr. FULTON. And 70 percent of the earth's surface is water, so there is quite a bit of leeway.

Admiral RABORN. Yes, sir.

The CHAIRMAN. Now, the Polaris is operated from a specially constructed craft, isn't it?

Admiral RABORN. Yes, sir.

The CHAIRMAN. That is the Polaris submarine?

Admiral RABORN. Yes.

The CHAIRMAN. What does it cost, that submarine?

Admiral RABORN. Presently they are costed out at a hundred million dollars a copy.

The CHAIRMAN. When it is completed at a cost of a hundred million dollars, how many Polaris missiles can it carry?

Admiral RABORN. The exact number is classified. I can say to you that it is more than 10 and it is a surprisingly large number.

The CHAIRMAN. And that submarine is perfectly mobile, with a full complement of missiles; it can move like any other submarine could anywhere, is that correct?

Admiral RABORN. Yes, sir.

The CHAIRMAN. Now, how far along are we with that program?

Admiral RABORN. We currently have six submarines under construction. The first submarine will be ready for active service in 1960. It is under construction at the Electric Boat Co. at Groton, Conn. It is quite well along.

I have some pictures of it I could show you in a classified briefing.

The CHAIRMAN. How long will it take to complete the program?

Admiral RABORN. This depends entirely on the numbers of submarines that it is finally decided to put into the program, sir. It is a continuing one.

The CHAIRMAN. How many have you announced to date?

Admiral RABORN. Six, sir.

The CHAIRMAN. Then it depends upon the money you get from Congress, I imagine?

Admiral RABORN. Yes, sir, and the force level that is desired.

The CHAIRMAN. Now, the missile is available, though, is it?

Admiral RABORN. The missile is under concurrent development, and it is just entering full-scale flight tests; very beginning.

The CHAIRMAN. Are you satisfied with the characteristics of the missile?

Admiral RABORN. We are quite pleased and satisfied with it.

The CHAIRMAN. What have you announced publicly as to its capabilities?

Admiral RABORN. It has been announced publicly that it falls within the size and range normally allotted to the intermediate range ballistic missiles, the IRBM class, sir. It is a solid propellant.

The CHAIRMAN. So it is an intermediate range missile?

Admiral RABORN. Yes, but married to the nuclear-powered submarine, this makes it equal to or from a standpoint of range, ICBM's or any other target of this kind. You could hit just about any target on the face of the globe.

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. This missile will be fired under water, I gather, or it can be fired either way?

Admiral RABORN. Yes.

Mr. ANFUSO. And that is not classified?

Admiral RABORN. You had me squirming for a moment, sir. I don't know.

The CHAIRMAN. It is in one of the statements there, that it can be fired above or below the water.

Mr. FULTON. Well, it has been fired at Canaveral on a pad.

Admiral RABORN. You will forgive me for being cautious. I was just trained this way.

Mr. ANFUSO. Let me ask you another question at the moment.

How about enemy detection? How could the enemy detect such a submarine?

Admiral RABORN. This is a matter we are spending great sums of money and effort on every year, in antisubmarine protection; because these waters and the shores are friendly waters, we think that we greatly compound any enemy detection effort that they may try to expend against this system.

Admiral HAYWARD. I think I better enlarge on that, because we can do this, and we also have the responsibility to protect the United States, and we are faced with a very large problem in this area. This is what worries me personally, that we always look over the North Pole, that the attack is coming over the North Pole. If you look at the map and everything, we have great exposed flanks. The ASW problem in the Navy itself is the No. 1 problem. The Polaris problem is also of No. 1 priority, but we have a tremendous problem facing us in that we cannot go down some of these anti-ICBM streets just coming over the North Pole. You have to look seaward, because if he is only 50 miles off your coast, he can destroy you just as well as if he comes from Russia. So we are faced with this problem, and a great percentage of my effort goes on the other side, which is to oppose the Polaris system in the enemy's hands.

Mr. FULTON. Could I ask one question?

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. It has been reported in the papers generally that the Polaris missile flight from Canaveral recently off a pad was unsuccessful. In congressional hearings I have learned that that flight was successful and was of great value to the Navy as to instrumentation.

Would you comment on that within the limits of secrecy?

Admiral RABORN. I would be pleased to, Mr. Fulton.

At this stage of development, I am sure the committee understands what we are trying to do is component testing. One of the purposes of this flight was to determine if we had fixed the troubles encountered in previous flights. They were fixed. It was also to get smoother burning, to detect if the burning of the propellant that pushes it through the air was smooth and even, the control of it, the separation of the motors at the right time, the ignition of the second stage. This was what we were trying to do in full-scale flight tests, and this was done, and for the purposes of this particular flight I think you have in question, we had about six out of seven of our primary objectives achieved. It was not entirely successful, but then no one in his right mind actually hopes that these early ones would be.

Mr. FULTON. So that actually it corrected six out of the seven deficiencies of the previous flight that were necessary to be corrected, and corrected them satisfactorily; is that correct?

Admiral RABORN. Six out of the seven objectives of the flight, yes. They were not deficiencies. We had only two deficiencies.

Mr. FULTON. And distance was not one of the primary objectives?

Admiral RABORN. It was not an objective at all.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Chairman.

Admiral, this is rather a simple question.

I am bothered by the speed at which things happen. Does the fact that you use a solid propellant make it possible to put a missile in the air more rapidly than if you use a liquid propellant?

Admiral RABORN. From our detailed study on this, yes. You see, we were partners with the Army in the Jupiter program for a period of some 6 to 8 months, and we, of course, delved into this at great length, and I can answer your question very clearly and straightforwardly in the affirmative.

The solid-propellent motor on a missile is a great deal like a cartridge in a gun. If you can aim the gun and pull the trigger, cock it, it will go any time you pull the trigger. It is just that simple.

Mr. ROUSH. Is the propellant stored in the missile?

Admiral RABORN. Yes, it is part and parcel of it. It is like the cartridge in a gun.

Mr. ANFUSO. Mr. Chairman, just one question.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Is it classified information to know the destructive capability of the Polaris as compared to the ICBM?

Admiral RABORN. Yes, sir; it is. The amount of yield in a warhead.

Mr. ANFUSO. Would you let us know that later, please?

Admiral RABORN. I would be pleased to, sir.

Mr. ANFUSO. I have no further questions.

The CHAIRMAN. Any further questions?

Now, what is the pleasure of the committee? Do you think we have enough time to go into executive session now?

All right, let's proceed, then, to go into executive session, and we will proceed as long as we can.

The committee will go into executive session and clear the room.

(Whereupon, at 3:12 p.m., the committee proceeded in executive session.)

EXECUTIVE SESSION

The committee continued in executive session at 3:15 p.m., in room 356, Old House Office Building, the Honorable Overton Brooks (chairman) presiding.

The CHAIRMAN. We have Capt. E. L. Wagner on the agenda. Could we hear him?

Admiral HAYWARD. Mr. Chairman, I would rather you go through and listen to Admiral Raborn because what Captain Wagner is going to cover is the Pacific Missile Range which is a service facility, but it will give you some idea of the magnitude, and why I want to bring it up.

The CHAIRMAN. Well, we will follow your lead on this hearing. Admiral, you just tell us now what you want. Is everybody here cleared for executive session?

Mr. Anfuso?

Mr. ANFUSO. The thought has always occurred to me—maybe it is because of my old experience with OSS—how security minded we Americans are. Now we have these open sessions and we may think that it is all right to let all of this stuff out in open sessions, even though they do become a matter of publication.

Nevertheless, we do let out a lot of information as to our weaknesses which can easily be reported, things that we are not going to do, programs that we are going to abandon, things of that kind, all of which is very useful information.

So I am just laying it out to you, Mr. Chairman, whether or not in the future in all of these hearings, public or private, whether Central Intelligence should not have somebody outside to just take a look at the people who come in at these hearings, public or private.

The CHAIRMAN. I want to say to my friend this: We will discuss that informally, if we may, to see that there are thorough safeguards about everything.

In the meantime we want to finish with the Navy, if we could, this afternoon. I will discuss it with you and with the other members of the committee. We will take the utmost precautions for secrecy.

Mr. MOELLER. Mr. Chairman, may I ask a question, please?

The CHAIRMAN. Yes.

Mr. MOELLER. I wonder also if we should get the impressions of these various branches of the service with respect to this. I gathered yesterday that there was a bit of dissatisfaction that possibly too much information was being circulated. Now maybe it was a false impression that I gathered. I do not know how the people of the naval branch feel about it, but I would think that they are as vitally interested in this as we are and we might attempt to get impressions from them also with respect to our policy on this.

The CHAIRMAN. Do you feel, Admiral, that there has been too much given to the committee?

Admiral HAYWARD. No, sir.

Mr. Chairman, I want to make one point clear. With my past experience with the Atomic Energy Commission I had to have complete confidence in the ability to come before the committee and tell them

the truth and nothing but the truth and what I thought. Now if I did not think it was right for the open session—I am no intelligence expert, I am a physicist—I would tell you this, that I did not think it should be in open session. But I have to be able to come to you in your committee and tell you what I think and what I believe. When I cannot do that, then you are in trouble, just as much as I am.

The CHAIRMAN. Well, I have been on these committees for 22 years taking these military secrets and all and as long as the committee accepts the information given to it, conscientiously and uses it in executive session as it is given to them, there is no trouble at all.

The military is on its own responsibility as to what it releases to the press. We are on our own responsibility that we let nothing get out of these executive sessions that should not be released.

Mr. ANFUSO. For example, Mr. Chairman, we know that Tass and even military attachés have covered our meetings. Now, where in the world can such a comparison be made? I am sure if we went to Russia nothing like that would ever happen.

Admiral HAYWARD. You must remember, Mr. Anfuso, the strength of our country is the strength of the people. We are a republic and if I cannot tell the truth before the people who run this Republic and it cannot get to the people, you cannot run our way of government this way. When I tell you something that you think is real secret, very often I can find it in a physics book, I can find it in encyclopedia. People get carried away with some of these technical things because they really do not know, but when we have something that is closed and should be in executive session, we tell you people everything. I have been in this business a long time, and I have never yet had a committee violate any of our confidences, to my knowledge, for use against the United States.

I think we have to be able to tell you this. A lot of times in open sessions as I said this morning, unless I get the word out to the press and to the people that this is an overall challenge and not just anti-ICBM or pro-ICBM, I am not doing my duty for the United States Government. That is what you people pay me for.

Mr. ANFUSO. That is what I want, Admiral.

Admiral HAYWARD. I know.

Mr. ANFUSO. I have said publicly right along that we ought to let the public know as much information as possible, but my thought was just as a precaution for us, no criticism of you.

The CHAIRMAN. I think the gentleman has well made his point strongly there, and I think we should follow it.

Now, Admiral, if you will, let us proceed with this before they have another bell.

Admiral RABORN. At this time I would like to show you a short progress report which will give the committee the substance of what we have been doing.

Will you please start the movie.

It is a sound movie, sir.

(Film shown.)

The CHAIRMAN. That is very fine. That is the bell over there for a vote on the bill.

Admiral, we can adjourn and finish the Navy hearing next week.

Admiral HAYWARD. Whenever it is convenient to you next week.

The CHAIRMAN. We will ask Mr. Ducander to communicate with you.

If there is no further business, we will adjourn until 10 o'clock tomorrow morning.

(Whereupon, the committee recessed, to reconvene at 10 a.m., Thursday, February 5, 1959.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONUATICS,
Washington, D.C., Thursday, February 5, 1959.

EXECUTIVE SESSION

The committee met in executive session at 10 a.m., in the caucus room, Old House Office Building, the Honorable Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will go into executive session.

Mr. Donovan.

We are sort of flying on one short wing and one long wing this morning. We will see how it works this way. One side has more members than the other side, with the chairman on the side.

Mr. FULTON. Would the Chairman yield?

The CHAIRMAN. I yield.

Mr. FULTON. I would like to put in the record the fine way the hearings have been conducted so far and thank the Chairman for his courtesy and his efficient methods.

The CHAIRMAN. We will certainly let the record show that. We appreciate that.

Mr. MILLER. Mr. Chairman, may I say the members who sit on your left have gone a long way to make for this fine cooperation.

The CHAIRMAN. We appreciate the cooperation of everyone on the committee. It makes it much easier if we have a single job to do, and we are trying to do it. I appreciate the kind remarks, however.

I might say, also, the microphones are off this morning for the reason that this is executive session and you have these offices behind. For that reason we thought the microphone should be off.

Now, if you members don't hear, I wish you would speak up.

We will ask the witness to raise his voice a little bit, and in the event, further, if you wish to come on this side, it would be all right.

Now, Mr. Allen F. Donovan, vice president, director, Astrovehicles Laboratory, Space Technology Laboratories, Inc., Los Angeles, Calif.

We are happy to have you, sir, as a witness before this committee.

We will have to adjourn about 5 minutes to 11.

Do you have a prepared statement, sir?

Mr. DONOVAN. No, I do not have a prepared statement. I would like to speak from what I have in my head and from what I have on some slides.

The CHAIRMAN. Fine.

STATEMENT OF ALLEN F. DONOVAN, VICE PRESIDENT AND DIRECTOR, ASTROVEHICLES, SPACE TECHNOLOGY LABORATORIES, INC., LOS ANGELES

Mr. DONOVAN. * * *

The CHAIRMAN. * * * Again let me thank you in behalf of the committee.

Mr. DONOVAN. Thank you very much.

The CHAIRMAN. The committee will stand in recess for 5 minutes.

(Whereupon at 11:00 a.m. the committee recessed, after which it proceeded in open session.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Thursday, February 5, 1959.

The committee met in open session at 11 a.m., in the caucus room, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will come to order, This morning we have as the first witness the Secretary of the Army, Hon. Wilber M. Brucker. I am going to suggest to the Secretary, if he will—he has a prepared statement, a copy of which is in the hands of every member of the committee—that he proceed with his statement without interruption. Then we might have the statement of Brigadier General Barclay without interruption and after that there may be questions. At any rate, we want to handle this as Secretary Brucker wishes it to be handled.

We are happy to have you, Mr. Secretary, and if you will, proceed with your statement as you wish.

Secretary BRUCKER. Mr. Chairman, members of the committee, I do have a brief statement and would like to read it. I think brevity will be better served.

I appreciate the opportunity to introduce the Army appearances before this committee and would like to make a brief comment on the Army's general interests and roles in the national missile and space programs. But first, Mr. Brooks, may I compliment you for your outstanding assistance and contributions to the military services during your tenure in Congress and especially for the exemplary work you did last year as a member of Mr. McCormack's very fine and worthwhile Select Committee on Space and Astronautics. We are very impressed by the way your committee has started out this year. We wish you the maximum of success and assure you that the Army will assist you and your committee in every way possible.

In preparing itself to perform its missions, the Army must explore any and all means which will increase its capabilities. Such a procedure is not merely desirable; it is mandatory, since science and technology today advance with such bewildering speed. This rapid advance in the state of the art, particularly in the past few years, has drastically and abruptly altered our traditional concepts of warfare. Our Nation and the Army cannot rely on historical precedent but must constantly seek to improve our capabilities through this technological advance. Specifically, earth satellites, ballistic missiles, and other manmade vehicles designed to travel through outer space or the upper limits of the earth's atmosphere provide highly promising

means for the Army to improve its ability to fight and accomplish its assigned missions.

The Army's capability in missiles and space has developed throughout its history. From the rocket used in the early 1800's to today's ballistic missile, the U.S. Army has demonstrated a continuous interest and capability in missile propulsion, guidance, production, and employment.

In 1944 the Army placed a contract—this was a $3 million contract—with the Jet Propulsion Laboratory at Pasadena for general research on guided missiles, with emphasis on rocket propulsion and supersonic aerodynamics. Since that date, 1944, under the auspices of the U.S. Army Ordnance Corps, a highly capable and successful military-civilian missile development team has been assembled. Part of the story of this team, such as the recruiting of German rocket scientists, is dramatic and has been well publicized. Less well known, however, is the continuous search into the unknown of space conducted by the Army in civilian laboratories and in Army arsenals over a 14-year period. This search has ranged from the V–1, the modified German V–2's, the Nike, the Corporal, and the Redstone missiles to the well-known, high performance, operational Jupiter.

Through periods of scant public interest in giant rockets, and modest Army budgets, active ballistic missile programs were maintained. It was this carefully developed missile and space capability which permitted the U.S. Army to reestablish the free world's technological confidence by placing Explorer I in orbit on January 31, 1958. This was accomplished 84 days from the date of the order to go ahead. This remarkable success was no accident; it was no miracle. It was the result of many years of painstaking study, research, development, test, and production involving the participation of many thousands of scientific, military, and industrial personnel. The capability which it reflected was not exclusive to a small group or a particular Army installation. The Army capability in space is associated in the public mind most frequently with the U.S. Army Ordnance Corps and the U.S. Army Ballistic Missile Agency. Without detracting from proper recognition which should be accorded to specific organizations and individuals, the U.S. Army capability is spread throughout the entire Army structure. It is a capability which is a composite of the skills, training, and experience of the Army as a whole and cannot be attributed solely to a single agency.

In accordance with your request, today's presentations are addressed to three fields of vital interest to the Army: Satellite and space vehicles; air and space defense weapons; and ballistic missiles with ranges of 200 statute miles and above.

General Dick, the Director of Special Weapons for Research and Development, will present the subjects of satellites and space defense.

General Beach, of the Office of the Deputy Chief of Staff for Military Operations, will discuss air defense and ballistic missiles; and Brigadier General Barclay, the commander of the Army Ballistic Missile Agency, ABMA, will provide information on the established relationships between the Army Ballistic Missile Agency, the Advanced Research Projects Agency, ARPA, and the National Aeronautics and Space Administration, NASA; and, in addition, will discuss the Army's emerging role in the national space program.

May I now introduce Brig. Gen. John A. Barclay, the commander of the Army Ballistic Missile Agency, following which both General Barclay and I will be very glad to answer any questions on which we may be of help.

Thank you very much.

The CHAIRMAN. Thank you, Mr. Secretary.

General Barclay.

STATEMENT OF BRIG. GEN. JOHN A. BARCLAY, COMMANDER, U.S. ARMY BALLISTIC MISSILE AGENCY

General BARCLAY. Mr. Chairman and members of the committee, I am Brig. Gen. John A. Barclay, commander, U.S. Army Ballistic Missile Agency, a subordinate agency of the U.S. Army Ordnance Missile Command located at Huntsville, Ala.

I will now present a brief statement which you have requested concerning the Army's work on projects as assigned by the Advanced Research Projects Agency and the National Aeronautics and Space Administration.

The timely and aggressive conduct of the national program for the civilian and military exploitation of space requires the efficient utilization of a substantial portion of the total national capability in space technology. In the short period since their inception, the National Aeronautics and Space Administration and the Advanced Research Projects Agency have made outstanding and praiseworthy advances in the effective channeling of this national capability toward the space objectives of the United States. In carrying out these objectives, it appears that NASA and ARPA are recognizing fully the often inseparable nature of the efforts of this Nation in meeting military and scientific objectives in both the missile and space fields, and are relying heavily upon the resources and capabilities of the military services.

In compliance with Executive Order 10793, dated December 3, 1958, the Department of Army and the Army Ordnance Missile Command entered into a cooperative agreement with the National Aeronautics and Space Administration. This agreement has placed the vast resources of the Department of Army at the disposal of NASA to accomplish the objectives of the national space program. Also, in the execution of the Department of Defense directive, dated February 7, 1958, the Advanced Research Projects Agency has directed the Department of the Army to accomplish a considerable number of individual projects in support of its military space objectives. I will present a summary of just how effectively the Department of the Army is fulfilling its obligations to NASA and ARPA in meeting their directives to date. No stone has been left unturned in our efforts to carry out the objectives of the national space program efficiently and expeditiously.

Under the terms of the cooperative agreement between NASA and the Army, the following Army capabilities and resources have been made available to NASA. These include:

1. The commanding general, Army Ordnance Missile Command, has been given full authority as the principal agent of the Army to utilize the vast resources of the Army and Army contractors for the accomplishment of assigned NASA projects.

2. It is contemplated that NASA will establish a team of resident personnel at the Army Ordnance Missile Command for technical contact and direction of effort on assigned NASA projects and to provide a continuing exchange of information on all projects assigned by NASA as well as exchange of information on supporting research in the entire missile and space field.

3. Key scientists of the Army have been made available to serve on NASA technical and advisory committees for the development of broad requirements and objectives in space programs and to assist in the determination of specific means by which NASA may accomplish its overall objective.

NASA agrees that the Army has been fully responsive under the terms of the agreement and that the two agencies will continue to work together to increase the effectiveness of the agreement.

These Army capabilities are being exploited by both NASA and ARPA under procedures mutually agreed upon with the Department of the Army and with the specific Army development agencies concerned. The Army's efforts in this area fall into three major categories:

First is the supplying of highly qualified people with specialized knowledge for participation in long- and short-range space program planning. In this connection we have supplied NASA and ARPA with our views on what the national space program should look like in the next 10 years from the vehicular standpoint. This suggested program would make maximum use of the major items of missile hardware under development in this country, regardless of whether an item is being developed under Army, Navy, or Air Force sponsorship.

Second is the accomplishment of assigned projects, including both space mission assignments and advanced technical development of large space vehicles and their components. In this area, the Army is in the process of conducting a challenging array of projects. The Army Ballistic Missile Agency has conducted to date a total of seven space-vehicle firings in support of the national space science program, now the responsibility of the NASA. These activities have resulted in the placing of three satellites in orbit, including the free world's first satellite—Explorer I—and the accomplishment of a space probe experiment which accomplished its major scientific mission. The missions of these vehicles have been directed toward the radiation mapping of extra terrestrial space—an area which is of vital concern to the planners and developers of advanced space projects, particularly those involving manned satellites and space vehicles. The results to date have been rewarding far beyond the original expectations of those who planned the experiments. A totally unexpected radiation phenomenon has been detected and initially investigated. A continuing series of space probe and scientific satellite launchings has been requested of AOMC by NASA and is scheduled for the near future. These missions will be carried out with the Juno II launching vehicle—the combination of the Jupiter missile booster and high-speed upper stages used in the launching of Pioneer III in December 1958.

One of the most vital and yet most critical phases of the national space program is the NASA-manned satellite project, designated Project Mercury. It is a vital project in that it represents the

initial fulfillment of the major overriding objective of the national space program—that of enabling man to explore and exploit the universe around him. It is the most critical space project to date in that it deals with human life. In recognition of the fundamental requirements for safety and reliability in such an undertaking, NASA has established a rigorous and intensive testing program designed to insure the anticipation and elimination of every possible hazard to human life prior to the placing of a man in orbit. The manned capsule for use in the final orbital project will first be subjected to a number of surface-to-surface ballistic missile flights. For the initiation of this test program, NASA has chosen the Army's Redstone missile. The Redstone is the safest and most reliable ballistic missile currently available. Fifty of these missiles have been fired since the inception of the Redstone program and in only one case, early in the program, would there have been any doubt as to the survival of a human passenger. Even in that case it is probable that appropriate built-in safety devices could have prevented a casualty.

NASA has requested AOMC to provide and fire eight Redstone missiles equipped with the NASA-manned space capsule, beginning in the near future. In addition, AOMC wil provide two Jupiter missiles with which the NASA capsule will be tested under the more severe environment conditions encountered along an IRBM trajectory.

Under the Advanced Research Projects Agency, the Army is carrying out a number of vehicular and payload development projects which are directed toward the immediate military application of space technology. The U.S. Army Signal Research and Development Laboratories are charged with the development of a meteorological satellite which will represent the initial step toward the provision to military commanders of weather forecasts of improved accuracy and timeliness which are so important to the success of military operations. Eventually, this effort may lead to a breakthrough which will make possible the active control of weather over a battle area.

The Signal Laboratories are also engaged in the design and development of satellites for application to rapid and reliable worldwide military communications. The initial orbital experiment in this area was conducted under Project Score in December 1958. The ultimate objective in the communications area is a network of communications relay satellites placed in orbits about the earth's Equator at an altitude of approximately 22,000 miles. At this altitude, each satellite will appear stationary relative to a point on the Equator and will thus make possible the almost instantaneous transmission of messages between any two points on earth.

Perhaps the most impressive single project currently assigned to the Army by ARPA is the development of the Juno V booster of 1½ million pounds thrust, now underway at the Army Ballistic Missile Agency. This vehicle, based on a cluster of improved Jupiter engines, will represent a truly significant step toward the early attainment of parity with the Soviet Union in weight-in-space capability. The Juno V booster will find applications to a large number of civilian as well as military missions of the next decade. This large booster will probably be of great importance in the achievement of the ultimate objectives outlined above with respect to both meteorological and communications satellite systems.

The third category of Army effort is the conduct of technical investigations, applied research, and feasibility studies as desired by NASA and ARPA, including mission selection and systems analyses. In this regard, under the direction of the Army Ordnance Missile Command, the Army Rocket and Guided Missile Agency is conducting and supervising research projects and feasibility studies for ARPA to advance the state of the art in solid propellent technology and to investigate new methods and components applicable to the problem of detecting, tracking, and destroying hostile ballistic missiles. In a closely related area, ARGMA and ABMA have already completed and submitted to ARPA preliminary studies in the area of defense against hostile satellites and space vehicles. The Army Ballistic Missile Agency, in cooperation with the Jet Propulsion Laboratory—now a NASA agency—is carrying out a study to determine an optimum deep-space research program for NASA. ABMA is also conducting for ARPA a systems study of an optimum multirange space vehicle based on the Juno V 1½-million-pound thrust booster. This study will consider various alternatives to upper stages for the Juno V which will be capable of conducting low-orbit, high-orbit, and space probe missions which require such a high-performance booster.

The Army developed its broad capabilities, which are now being used in space projects, as an inevitable result of its progressive work and outstanding success in the field of military missiles. The Army is gratified that as a result of this developed capability it can lend substantial support and assistance to the vital national space program. We believe that not only will this participation serve to further the accomplishment of the Nation's objectives, but also contribute to improved techniques and systems of direct benefit to the Army. The close relationship between missile and space technology is such that improved Army missiles and missile components will result from our space efforts. The Army's capabilities for satisfying its requirements and carrying out its responsibilities in the areas of worldwide communications, worldwide mapping and meteorology will be greatly improved through the experience gained and the components developed in the space program.

Of major importance also is the contribution which our efforts under Project Mercury will make toward the evolution of transport missiles for the deployment of Army troop units and combat teams and the logistic support of Army battle area operations.

I have appreciated this opportunity of appearing before the committee and shall be happy to answer any questions you may have.

The CHAIRMAN. Thank you, General, for a very fine statement.

Secretary BRUCKER. May I supplement this with just one statement.

The CHAIRMAN. Yes.

Secretary BRUCKER. It is implicit in the statements which we have given you this morning, but I think maybe we might have been a little clearer in stating two things here.

On December 3, 1958, Mr. Chairman and members, we entered into cooperative agreements with the National Aeronautics and Space Administration. One agreement provided for turning over the Jet Propulsion Laboratory at Pasadena, Calif., to the NASA which I mentioned in my opening statement and to which General Barclay

alluded. That was effective forthwith, and since December 3, JPL has been under NASA control, the arrangement being that the Army and NASA under the administration of the latter will cooperate to see that the cooperative effort is developed fully.

At the same time as a counterpart, or contemporaneous with it, was an agreement whereby the Army retained the Army Ballistic Missile Agency but provided for a cooperative agreement again with NASA whereby it should have all of the benefits of using the Army Ballistic Missile Agency, its contractors, the Army's contractors, industrialists, our university researchers, our scientists, and those who have worked with the Army and all of our support agencies, to include our technical services such as the Signal Corps, and all of the rest. That agreement is likewise in full bloom at the present time.

Now the second bit of information that we should have supplied, I think, is this: When General Barclay and I spoke about the Redstone and the Jupiter, we take it for granted, of course, that the committee knows the range of those two. The Redstone missile is the one capable of 200 statute miles. It was referred to here by General Barclay as having such reliability that only in 1 of the 50 firings we made was there a question as to whether a man could have successfully been placed in space. I am referring to the 200-statute-mile Redstone. That was the first one developed by the Army Missile Agency at Redstone; and the other was the Jupiter.

You notice he made some distinction about the fact that the Jupiter had been tested on missile firings and likewise would be tested as to the man in space or using of a man in connection with certain Jupiter firings. The Jupiter is a 1,500-mile intermediate range ballistic missile. Those are the two things that I wanted to have said. I would like to say something that I did not at the beginning. I should have introduced at the very beginning the Vice Chief of Staff, Gen. Lyman Lemnitzer who is here at my side. I trust you will all forgive me.

The CHAIRMAN. General, do you wish to make a statement?

General LEMNITZER. No, Mr. Chairman, I do not have a statement.

The CHAIRMAN. Mr. McCormack has to leave early because of official duties on the floor, so I am going to recognize him for any questions at this time.

Mr. MCCORMACK. I only have one or two questions. Because we get more information in executive session than we can in public session. I realize that, and you gentlemen are under restraint. We might ask questions in good faith that you know could be better answered in executive session, I look more to the executive session for real information, because there are times when you cannot make public certain information in the interest of our country and nobody would want that.

It is contemplated that NASA will establish a team of resident personnel at the Army Ordnance Missile Command for technical contact, and so forth. Has that been done yet?

Secretary BRUCKER. I would like to have you answer that, General Barclay.

General BARCLAY. Not as yet, Mr. McCormack. This, of course, is a reciprocal arrangement. The Army Ballistic Missile Agency and the Army Missile Command currently have two engineers resident with the NASA organization at Langley Field. Those personnel reported there the middle of January. NASA personnel are planned

to come in residence at the Army Ballistic Missile Agency and the Missile Command at Redstone but they have not yet joined our staff. We have in residence with us a group from the Jet Propulsion Laboratory who worked in the coordination of our projects prior to the time the Jet Propulsion Laboratory was transferred to the administrative control of NASA. These personnel of the Jet Propulsion Laboratory are remaining in residence with us at the Missile Command.

Mr. McCormack. The cooperative agreement was made when?

Secretary Brucker. Signed December 3, 1958, sir. It was made prior to that time, of course, during the month of November.

Mr. McCormack. We hear a lot about the flight to the Moon and to Venus and Mars, which is very interesting and very important. I recognize that emphasis must be put on it, but from a military standpoint is there any military significance in the immediate or foreseeable future, from say a flight to the moon or around the moon?

General Barclay. Yes, Mr. Congressman, I feel that there is. We are unable to appreciate the military potential of exploitation of space until we know the possibilities. We must do this from the scientific point of view and once we have learned what we can do in space and learned how we may be able to exist in space, we can then better appreciate the military potential of it.

Mr. McCormack. I noticed your statement that the Army is carrying out a number of vehicular and payload development projects which are directed toward the immediate military application of space technology. I assume from that that you have definitely in mind, that while we have the overall program in the years ahead, that it is vitally important in the world of today, from a military angle, that we do not slip up on anything.

General Barclay. Yes, sir, I feel very strongly that that is the case, that we must be abreast of the potential of travel in space and able to command space and utilize it as it offers. Until we have determined scientifically the many things which are unknown at the present time, we cannot fully realize its potential. There is much research to be done. We do not know how materials will react under the vacuum of space over long periods of time. We do not know how lubricants on bearings will stand up under the radiation which we know exists in space and how our systems may continue to operate in space under long periods of time when they may not be accessible to maintenance or repair. There are many other areas such as the effect of meteorites upon satellites and space vehicles which we must learn about. There is a great deal of research that must go forward, and step by step, we will gradually build our capability to utilize space to meet our needs.

Mr. McCormack. Well, I can understand that, but in my mind there is the immediate problem of confronting not only our country but the future world—of not always following but being ahead of any potential enemy in connection with military developments in the world of today. I assume from the language you use that you are speaking of space in general, but it is still language which conveys to the objective mind that the Army has got in mind the military possibilities.

General Barclay. Yes, sir, we have. These programs, however, must be rather long-range programs because of the amount of research

work that must be done and the development work of missiles and missile systems. In order to be ahead we must establish forward-looking goals that we will be achieving in the 1965–70 time span. I think it is only by this means that we can assure not only being abreast of other nations in the world but being ahead of them.

Mr. McCormack. Well, how do ARPA and the Army get along, and NASA? I will not ask about the Air Force, they can speak for themselves. How has your relationship been?

General Barclay. Our relationship has been a very active one, a very close one, and a very congenial one. We have found that ARPA has the ability to face up to problems, to make rapid decisions, and to take action to implement programs rapidly. They have initiated the large booster project which is the first priority requirement for the United States to advance in space; that is, to develop power systems capable of launching into orbit the large payloads that will be needed. That is being undertaken using the Jupiter engine in a clustered configuration which will give us a total thrust of a million and a half pounds.

Mr. McCormack. When?

General Barclay. The first test of that will be accomplished within the near future. I would prefer to discuss the details in executive session.

Mr. McCormack. Fine. Thank you. That is all.

The Chairman. I want to ask you this, General, if I may: You refer to the fact that 50 of these missiles, that is the Redstone missile which has a range of 200 miles have been fired and that in only one case there has been any doubt as to the survival of a human passenger.

Now in reference to that, do you mean that the conditions within the missile were such that you know a human passenger would have survived or do you mean that the missile performed according to hopes and expectations in its trajectory and its career until it returned to the earth?

General Barclay. The missile flight was such that if it had contained a human as a passenger, he would have survived the flight. There was one flight, the third Redstone missile, which rose only a short distance off the pad, the motor stopped, and the missile fell back on the pad and burned.

The Chairman. Well, that is not quite what I had in mind. You do not mean that you have conquered all conditions of survival for an individual had he used that particular missile, do you?

General Barclay. No, sir, I do not.

The Chairman. The speed of take-off and reentry and all of those things.

General Barclay. The missile flight was satisfactory so that if we had had a capsule available for a human being with the safety devices and escape devices which are now planned, the man would have reentered successfully or would have been able to eject himself and return safely to the earth.

The Chairman. Is there any particular advantage, in a military aspect, to accomplishing that? Suppose we put a man in a 200-mile missile. Is there any particular military advantage in learning to do that?

General BARCLAY. Yes, sir, there is. In the first place in connection with the development of an ability to place men in space and recover them, it is essential that we develop our systems and check them out at short ranges. We must crawl before we walk. In the future when we have developed these techniques it appears quite practical that we may deploy both high-priority cargo and personnel to critical battle areas which are not accessible by any other means. The accuracy of placing personnel into an area with a missile will be far greater than that by aircraft.

The CHAIRMAN. In other words, transportation.

General BARCLAY. That is correct.

The CHAIRMAN. What about this Juno II rocket that you are referring to in your statement?

General BARCLAY. The Juno II is a successor to the Jupiter–C which has been used to place the Army's Explorers in orbit. The Juno II is essentially the same system incorporating in its first stage a Jupiter intermediate range ballistic missile with a slightly elongated fuel tank and containing as the top three stages the jet propulsion laboratory configuration for placing a satellite vehicle in orbit.

The CHAIRMAN. That name is obtained from mythology?

General BARCLAY. That is correct, yes.

The CHAIRMAN. I want to ask this, Mr. Secretary, and from all of you: In reference to the project that you have, the missile project for the Army, do you have an adequate amount of money to carry on that project? Is it moving along satisfactorily now?

Secretary BRUCKER. Are you referring particularly to the Redstone and Jupiter project, sir, and also to the Juno and these other projects?

The CHAIRMAN. All of the missile projects that the Army is maintaining at this time. What I am trying to learn is: Is there any effort to cut off the Army in the development of its program? The Army program has been a very satisfactory program.

Secretary BRUCKER. Well, we are operating on a modest budget and we have funds for the continuance of the Redstone for the foreseeable future. The 1959 funds that we have give us the chance to operate that and the means to complete it during the fiscal year 1959, and also the calendar year 1960. The 1960 budget, however, does not carry any money for the Redstone missile.

The CHAIRMAN. Do you interpret that to mean they are trying to choke off the Redstone plant?

Secretary BRUCKER. Well, I interpret that as meaning that the Pershing, which is a solid propellant missile of slightly greater range, will replace the 200-mile Redstone. Since the Pershing is a solid propellant missile it will be more effective in the field with troops.

The CHAIRMAN. Well, that would not be an effort to choke off your operations, but it would be a continuation of the operations along another line; is that not correct?

Secretary BRUCKER. Yes, it would be a continuation at a greater range. There is a time gap in there between the time when the production of the Redstone would be concluded and the time when the Pershing will be operational.

Now as to the Jupiter, we are producing it for the Air Force under the arrangement and order of the Department of Defense. We are producing sufficient for three full squadrons. That work likewise

will continue during calendar 1959 and most of 1960. We have no further orders on it beyond that, and we are subject to whatever the Air Force and/or the Department of Defense may order in that regard.

The CHAIRMAN. Does that fill the requirements for the Jupiter?

Secretary BRUCKER. It gives us enough Jupiters in the meantime so that we can do experimental work during this calendar year and most of 1960.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We are glad to have you here, Mr. Secretary, and I, personally, want to thank you for your complete cooperation and also General Lemnitzer for his cooperation.

The question of going into outer space is, of course, with what concept do we go into it. Are we going into outer space with the theory of freedom of the seas and to maintain an open and clear outer space so that nobody can control it, or are we going to take Britain's theory of the dominion of the seas? Is our purpose to get control, or power to control, and prevent any other nation or group of nations from having the similar control? What is our purpose militarily?

Secretary BRUCKER. From a military standpoint while I do not, of course, speak for the Secretary of Defense, the philosophy is this, I think: We are going into space to do all of the exploring that we can to find out every possible and conceivable scientific advantage and to get not only the knowledge and the experience and the know-how, but the ability to put tangible physical satellites and things of that nature, in orbit. These satellites may be stationary in the sense that they hover over one part of the world—or they may be moving constantly around.

Mr. FULTON. That brings me to my next question, the jurisdiction of the Army in space. What is it? You have, of course, other surface-to-surface missiles. You would have surface-to-water and surface-to-air, but you would not have air-to-air and you would not have air-to-water, and you would not have water-to-water in the Army.

Secretary BRUCKER. That is right.

Mr. FULTON. Now I understood from your previous presentation that you felt that the Army should be in the orbiting vehicle business. Now would you have the Army have that jurisdiction or would you just have surface-to-air and surface-to-surface and surface-to-water?

Secretary BRUCKER. Mr. Fulton, I do not believe that at this time there is any clear demarcation or definition of where any peaceful or military use starts or leaves off, or where any defense interest in any one of the services or ARPA begins or leaves off, and maybe it is better that there is not, right at the moment. Because, as we move into this field, to have rigidity and inflexibility at this time might not be a good thing for the whole effort. It might be best to have a little obfuscation or blurring of the line between the two.

Mr. FULTON. There is plenty of obfuscation.

Secretary BRUCKER. Maybe that word is a good one. But I think it is better at this time that these lines are not too clearly drawn by inclusion and exclusion.

Mr. FULTON. So we really have some competition on going into space among the various services, militarily as well as in peacetime use.

Secretary BRUCKER. I would agree to some competition: Providing it is monitored and supervised and not just free competition with a

cutthroat idea, without regard to the national interest. This supervision of the three military departments is provided by ARPA, through whom or through which agency we must submit everything and have it approved before anything can go. The same applies to NASA. Nothing can happen without NASA approving it on the other side, and I think those are good controls and supervisions at this time.

Mr. McCormack. Would the gentleman yield there?

Mr. Fulton. I would be glad to yield.

Mr. McCormack. Who would you suggest to be the monitor?

Secretary Brucker. The monitor?

Mr. McCormack. Yes.

Secretary Brucker. Well, I think ARPA, the Advanced Research Projects Agency with the Secretary of Defense in overall command is the proper authority on our part. We must not go ahead without the monitorship of that agency of the Department of Defense. Both ARPA and NASA are subject to the National Space Council, of course, and I think that is a proper arrangement.

The Chairman. Mr. Secretary, in reference to NASA, does the Army Ballistic Missile Agency act as a contractor? What is the relation with NASA?

Secretary Brucker. That is a good question, Mr. Brooks. I am very glad you asked that. With your indulgence I will say this: It is not a contract relationship in the ordinary sense of the word. There is what is called a cooperative agreement that was drafted between the two agencies of Government and signed by both, approved by the Council and of course by the President. It is an agreement whereby instead of having some standoff relationship at arm's length, it is a very intimate relationship where projects have the whole and compelte attention and the opportunity to benefit by the services of every part of the Army organization.

In other words, NASA has not only what they would get by ordinary contract with a private contractor, but they get all of that which the Army has with respect to its university research, its arsenal research, its in-house development capability, its technical services, such mundane things as supplies and equipment and all the rest that is available to the Army.

In other words, it gets the whole backing and support of the Army instead of just an arm's length contract arrangement. So it is a cooperative agreement in every sense of the word and we hope that it will show to all of the agencies of Government what you can do when you get together and really cooperate to make a thing go because it must go.

The Chairman. Well, is it reciprocal? Do you get the same thing from NASA that you give to NASA?

Secretary Brucker. Yes, it is reciprocal in that NASA gives us consideration with respect to projects. That is the quid pro quo that we get. In other words, we are anxious to do their work because it helps advance our military missile technology. So we display to them our wares, the support that we can give them, and they in turn say to us you are qualified to get this project, whatever it happens to be, a lunar probe, or something else, and we take that on, and we are interested in that as our quid pro quo.

So there is a cooperative reason on both sides to cooperate.

Mr. McCormack. What about going a step further beyond cooperative and making it coordinating?

Secretary Brucker. I think maybe that is the word.

Mr. McCormack. I thought you meant that.

Secretary Brucker. I do. I am glad you added that, Mr. McCormack; I want to add another word on the exchange of information. There is a day-by-day, week-by-week exchange of detailed technical information, because one hand washes the other in this business. What we learn about missiles redounds to their benefit and development in the field of science for space generally. What they get in space generally redounds to our advantage in missiles because the two efforts are so close together, like the interlacing of fingers. They work together to help all of us. That is why we think this arrangement ought to work out well for the Army as well as for NASA in the long run.

Mr. McCormack. We must realize that many of the results of the military work and experiments and activities will inure to mankind, and have frequently in the past.

Secretary Brucker. That is correct.

Mr. McCormack. It is a question of understanding men working together who have in mind the interest of our country.

Secretary Brucker. It is whether the men will make it work that counts.

Mr. McCormack. That is also necessary between the executive and the legislative, and vice versa.

Secretary Brucker. Yes, indeed.

The Chairman. Mr. Fulton.

Mr. Fulton. You have spoken of the reliability of the Redstone and said that it is high. For example, Rocketdyne makes the motors and engines for the Redstone, the Thor, the Jupiter, and the Atlas.

Now the Air Force recently has announced that the Thor is up to 50 percent reliability and they expect to have that up to 80 percent by the end of the year. I believe Rocketdyne says they are going to have it above 90 percent if they can. The question is: On the Jupiter, can you give us the present state of reliability of the Jupiter and this same progress that the Air Force has already announced?

Secretary Brucker. I just wonder here about——

Mr. Fulton. I want you to be as open as the Air Force.

Secretary Brucker. We don't want to indulge in any self-interest here, but I just wonder about the classification, because of the nature of this work. I think inasmuch as the Air Force has made a statement on the subject, that we are certainly entitled to make a statement.

Mr. Fulton. It is in print.

Secretary Brucker. General Barclay.

General Barclay. Mr. Congressman, I mentioned earlier that the Redstone has had 50 flights, only one of which we considered a complete failure, in that the objectives were not achieved.

Bear in mind that the Jupiter, being a successor to the Redstone, has inherited many common components and principles of design which went into the Redstone and has, therefore, a heritage of reliability.

To be more specific, the last six Jupiter missiles which have been fired were completely successful in five cases and went the full range. The sixth one, which failed after some 40 seconds of flight, failed due to the failure of a component which was put on it for instrumentation purposes and which was not a basic component of the stockpile missile.

In addition to these six flights of the Jupiter, we fired the lunar probe in December, which had the basic propulsion unit of the Jupiter, and was fully successful through the operation of the first stage.

That is our record since the difficulties with the motor were ironed out. Those difficulties, of course, were common to the motors of both our IRBM systems and our ICBM system.

Mr. FULTON. So that on the manufactured missile, as well as on the fuel, you have had seven successful flights?

General BARCLAY. Of the last seven, six were successful.

Mr. FULTON. One was a component not necessary for the operation of the missile?

General BARCLAY. That is correct. That failure was not attributed to a missile component but to instrumentation.

Mr. FULTON. So let me give you the hundred percent record, which I am trying to do.

Secretary BRUCKER. Just to answer that question a little more fully, General Barclay will indicate that we have had a lot more than six or seven flights of Jupiter. I think he ought to tell about that.

General BARCLAY. Yes, sir; I referred to the last six flights, which are those that have taken place since the motor trouble was corrected.

Mr. FULTON. I realized that.

General BARCLAY. Our first two flights we considered partially successful only because they did not go the full motor-burning time. In the first case we lost the missile due to a heating condition that existed in the tail. In the case of the second missile, we lost that due to a sloshing of the missile fuel. The third Jupiter fired was fully successful and went the full range.

The next two missiles were also successful. Then we had two failures due to motor difficulties, which were cleared up, and subsequently the seven flights which I referred to.

Secretary BRUCKER. I wanted you to have the full statement there.

Mr. FULTON. I want to say this, Mr. Chairman: As I am the only Republican here, possibly as an eager beaver, I am going to make up for the horses against the rabbit on this side.

Mr. ANFUSO. Jim, I think you would want to take that off the record, to show the lack of interest on the part of the Republicans.

Mr. FULTON. I said I made up for that.

Mr. ANFUSO. I think you can. You are very capable.

The CHAIRMAN. We have a rollcall, and the rollcall will indicate those present.

Mr. FULTON. Under subsection (f), labeled "Outer space and the control thereof," of the resolution passed setting up this committee, this committee was given a peculiar jurisdiction. I want to call your attention to it specifically, because (f) says that we have the jurisdiction of outer space, including the exploration and control thereof. So whether you are civilian or military, when you come into outer space, as such, as distinguished from the ionosphere, that jurisdiction is under this committee.

Now, the question comes up. If somebody lands on the moon, because we will have jurisdiction of the moon, will the Army be operating on the moon as such? Is that Army territory? It is ground? And do you then therefore—suppose there is an occupation of the moon militarily, should we therefore have the Army in charge of the moon?

Secretary BRUCKER. Mr. Fulton, I haven't given careful attention to that matter of jurisdiction of the moon or of the flight, and I would want to give it a second thought before I answered it here.

Mr. FULTON. The proposal on the man to the moon is that there would be three people there. I imagine there would be a Navy man, an Air Force man, and an Army man. But if we don't get there in time, we may have to have a marine to make a landing—the Russians may be there first.

The CHAIRMAN. Now, Mr. Miller has a question.

I want to give everybody an opportunity for a brief question here before we are called on the floor.

Mr. MILLER. Mr. Secretary, is the Army's work in space interfering with its work in missiles or, vice versa, is its work in missiles interfering with its work in space?

Secretary BRUCKER. On the contrary, it is augmenting, supplementing, and assisting our work in connection with missiles, so that the Army feels that one hand is really washing the other, and that we are getting benefit out of it.

Mr. MILLER. Is the Army satisfied——

Did you have something further?

General BARCLAY. I mentioned in my statement, Mr. Congressman, that we get mutual benefit in working in our missile program and our programs in space. What we develop for NASA and ARPA is applicable to our military missile systems, and the converse is true.

Mr. MILLER. Mr. Secretary, is the Army satisfied with its current arrangements between your ballistic missile center and NASA?

Secretary BRUCKER. Yes, we are, Mr. Miller, and we are ready to go forward in good faith and to carry out not only the letter but the spirit of the arrangement. We are doing it.

Mr. MILLER. Mr. Fulton raised one question as to outer space, which concerned the Army in outer space.

General Barclay has discussed the desirability of having this missile or satellite fixed with relation to some place on earth, because it would be a means of communication.

The Army is always concerned with communication, is it not?

Secretary BRUCKER. It is.

Mr. MILLER. And the work that would be done in the field of weather that could come out of this thing is of utmost importance to the Army?

Secretary BRUCKER. Very important.

Mr. MILLER. So that you do have a very material interest in outer space or inner space or wherever we can best develop these two things. Isn't that true?

Secretary BRUCKER. We feel we have a very critical and very important interest in it.

Mr. MILLER. I would like to discuss the limitations put on you, but I don't think perhaps this is the place. But as a last question, somebody has referred to Juno being taken from mythology, and I

am not too familiar with mythology. And then just coming on this committee, the jargon of outer space kind of gets me down a bit.

But we heard a lot the other day about aerospace, a new word, "aerospace." Are you familiar with the word "aerospace"?

Secretary BRUCKER. I know about the word, but I am not familiar with the claims made for it.

Mr. MILLER. Have you any comment to make on aerospace and who controls aerospace?

The CHAIRMAN. The Secretary is probably more familiar with "armospace."

Secretary BRUCKER. That is right.

Mr. MILLER. I wanted to say to General Barclay, as an old artilleryman, I am certain that you realize that during World War I we were taught one could disregard the 2 percents. So I think in this case you had 50 firings and only 2 percent went wrong. That is as near perfect as you can get.

General BARCLAY. I was going to add, we have designed the Redstone missile to have artillery accuracy.

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Secretary, I want the record to show that I think that you are a great Secretary of the Army, even though you are not of my party. I think you have done an excellent job.

Secretary BRUCKER. Thank you very much.

Mr. ANFUSO. I want that in the record.

Secretary BRUCKER. Thank you very much.

Mr. ANFUSO. Mr. Secretary, Mr. McCormack asked a question of whether there was any great priority to shoot for the moon, and I think that that question was very carefully and well answered.

Now, would you state that there is any priority to shoot for the exploration of Venus and Mars at this time or can you place other priorities in advance of that?

Secretary BRUCKER. I have been conferring with General Lemnitzer here because that is really a concern of NASA, and I think under the circumstances we should defer to them on that, because they make the decision and while we present, they dispose of it.

Mr. ANFUSO. Thank you.

Mr. Secretary, you have spoken about having a modest budget, which has been sufficient to carry out the projects that you have already mentioned.

Now, in carrying out these projects, will that enable us to catch up with the Russians or pass them, or must we do something more?

Secretary BRUCKER. Do you mean in the field of these experiments that we are making?

Mr. ANFUSO. Yes.

Secretary BRUCKER. Well, Mr. Congressman, I think you would have to take all of the effort together that the military is making in order to get an answer on this.

As far as we are concerned, we have sufficient projects—as far as we can press on this at the present time—and NASA and ARPA have indicated to us that they will support other projects that they are going to turn over to us and the Army.

I can't speak, of course, on the overall, because I don't know what the arrangement would be with the Air Force and the Navy, and what the sum-total would be. But as far as we are concerned, we have in promise or in being now sufficient projects to keep us moving along in this field.

I would like General Barclay, who is right on the floor here, to supplement that, if he would like.

General BARCLAY. Yes.

To catch up is, of course, dependent upon two things: how fast the other fellow is going and how fast we are willing to go.

Certainly we have set goals and we have initiated programs which will provide us a capability, and that capability will come primarily through the development of large power systems, large engines and thrust units which will permit us to engage in a weight-lifting contest with other nations, if you want to express it that way.

Mr. ANFUSO. Well, General, are you satisfied that we are going fast enough?

General BARCLAY. I believe we could go with greater assurance. We have had our programs funded so that we can make progress. There are some things, however, that would be desirable to give greater assurance and reliability in our programs, which we have not been able to do under the present funding.

Mr. ANFUSO. Has the Army suggested other projects for which it has been unable to get the funds to carry them out?

General BARCLAY. Yes, sir, we have. We have made proposals to both ARPA and NASA, and we have further projects under study, at their request, for presentation to them.

These studies, of course, have not been given to ARPA for their consideration and decision as yet.

Mr. ANFUSO. You have not as yet given them out?

General BARCLAY. Not as yet; that is correct.

Mr. ANFUSO. But you have them under consideration?

General BARCLAY. That is correct.

Mr. ANFUSO. All of which, if you got the money for them, would enable us to move faster; is that the idea?

General BARCLAY. I feel if our long-range objectives are established and carried forward with resolution and with adequate funding that in a few years we will be in our rightful place in this area.

Mr. ANFUSO. Thank you very much.

Mr. Chairman, at the request of Mr. Sisk, I promised I would ask two questions.

The CHAIRMAN. Can we recognize Mr. Roush? I want to recognize as many as I can, and then we will get your questions in.

Mr. ROUSH. Mr. Chairman, I think I can speak loud enough so that I can be heard without the use of the microphone.

General, there is a question in my mind. I am an old infantry soldier, and I realize the importance of being able to control the weather, and you spoke of the possibility of a breakthrough.

Is there a definite relationship between the control of space and this possibility of controlling weather? Do we have any evidence of that yet?

General BARCLAY. Mr. Congressman, our weather of course exists primarily up to some 80,000 or 100,000 feet. Space we normally con-

sider as beyond that. Our study of the weather, cloud coverings, and the formation and movement of air masses and winds, which we hope to achieve when we can look down on our earth and on our weather in the making, we feel may give us means of controlling weather.

Mr. ROUSH. In other words, right now you are concerned about the ability to predict the weather, which you hope will eventually lead to the possibility of the control of weather?

General BARCLAY. Yes, sir; when we can accurately predict it, we think we may find means of controlling it.

Mr. ROUSH. And if we have means of controlling it, it will have great peacetime significance as well as wartime significance?

General BARCLAY. Yes; that is correct.

Mr. ROUSH. Maybe I won't need the dams which I am hoping my area will get.

Thank you, Mr. Chairman.

The CHAIRMAN. Any further questions?

Mr. HECHLER. Mr. Secretary, one of the witnesses indicated yesterday the desirability of a more centralized, single U.S. space agency. This witness expressed some concern as to whether this program might be bogged down by bureaucracy.

I gather from your testimony that you feel that the coordinating efforts of existing agencies are sufficient under the arrangement we now have.

I wonder if you would care to comment on the proposal that an agency designed along the lines of the Atomic Energy Commission, with a military applications division, can be created in order to pull this program together or do you feel that the current administrative arrangements are satisfactory?

Secretary BRUCKER. I feel that it is in an early stage to be talking about reorganizing what is in existence at the present time, and I approach my answer to you in that way.

I believe that what we have now should be lived with, implemented, assisted, coordinated, and so on, until we see what the bugs are and the problems that arise. I don't believe that it is wise at this stage to engage in reorganizing and changing the structures.

I think now the thing to do is live with what we have, get along with it, work with it, find out its deficiencies and inadequacies and then your committee and others will recognize that and make the proper modifications and changes.

Now, in the sense of the AEC, we have one of the parallel agencies now. It is the Civilian-Military Liaison Committee, with members, of course, from the Department of Defense and each of the services, who meet and report monthly. That liaison committee will do a lot to keep this thing in balance. That is patterned after the structure of the relationship between the Defense Department and the AEC. So that is a parallel that has been transplanted over.

I do feel that there are things, of course, that can be improved upon as time goes along, but at the present time I am emphatically answering to you that I think this is a satisfactory arrangement.

The statute is well founded, and the agencies that you have with the Space Council, the Space Administration, and ARPA with Defense, and the services under that, this is a working arrangement. If men of good will work together with it, we can get along and make great advances, much more than we have up to date.

Mr. HECHLER. Thank you.

The CHAIRMAN. Any further questions?

Mr. KING. Mr. Chairman.

The CHAIRMAN. Mr. King.

Mr. KING. Exploring this point about which you have just testified a little further, to a layman it does seem a little singular that you have three branches of our service and now, of course, NASA, making a fourth, all engaged in a space program, with the inevitable overlapping, and there is bound to be duplication, as you testified.

I just raise the question, is that not resulting in a duplication of effort that raises the costs rather appreciably and something the Congress might be interested in?

Secretary BRUCKER. I think you raised a good point, duplication of costs. At the present time ARPA is not an independent agency in the sense that it is an overlap on the three organizations. It is more of a monitoring organization so it does not spend money of its own for itself but for projects which it approves and releases.

Now most of these projects, if not all, are released to one or more of the military services. We each have sort of a permanent liaison by representation at ARPA. ARPA has members from each of the services in its employ and without reference to the service they are all in on the question of what projects are being applied for and what projects are being let to the different services. They all know what the other services are promoting or suggesting. Now ARPA is very careful and I want to give ARPA credit for that. They have been very careful to see there is a minimum of overlapping. There is bound to be some overlapping. There cannot be a clear line of demarcation on every one of these projects because they have elements of similarity and I do not want to mislead you, but to the limits of ARPA's ability and the limits of our ability in the service I think it is going along very well.

I do think, of course, that the Secretary of Defense should constantly review the operation of the ARPA to make sure that what Congress directs is carried out and that every dollar is saved. But, the fact that a thing overlaps in the research and development field at this stage is not dangerous if it is not perpetuated for any length of time and if the followup steps are taken at the proper time by the agency concerned.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. General Barclay, you referred to the communications objectives of these equatorial satellites, which will go around this 22,000-mile orbit, as I understand it, and will be sort of stationary. What is to prevent the Russians from shooting them down once we get them up there?

General BARCLAY. That, of course, is always a possibility that any target is susceptible to, if they have the capability they can do that.

Mr. DADDARIO. Would it not seem, then, that they would have that capacity, and this would be one of our objectives that we are spending money on which should be directed in another direction? For example, we could have such an observation post on the moon where you could set up some sort of defense against this particular type of counterattack, countermeasure.

General BARCLAY. I feel sure the Russians have given consideration to that possibility. If I may, I prefer to respond in detail in executive session.

The CHAIRMAN. Mr. Anfuso, you have some more questions.

Mr. ANFUSO. Yes, Mr. Chairman. I want the record to show I am asking these two questions on behalf of Mr. Sisk who had to go on the floor.

Mr. Secretary, since your agreement of December 3, 1958, have you issued supplemental or implementing instructions to ABMA regarding work for NASA?

Secretary BRUCKER. I have conferred personally with the head of that agency, the Army Ordnance Missile Command, that is General Medaris. Then his next officer in command is the Army Ballistic Missile Agency commanding officer, General Barclay. I have always talked to them. I have also talked to Dr. von Braun personally with reference to it and likewise this has been paralleled by the Chief of Staff and by the Vice Chief of Staff with respect to our ordnance personnel and others down the line. Because of the fact that the Army Ballistic Missile Agency is given such a direct line, it does not have to come up through channels and the top personnel have access directly to my office. Because of that, our relation is so close that we have not issued formal printed or written regulations but there are perfectly clear oral instructions as to how that shall be implemented.

I think General Barclay ought to add just a word to that.

General BARCLAY. Yes, Mr. Secretary. To put it succinctly, Army policy has been established by the Secretary and as we express it, that Army policy is "Never say 'No' to NASA."

Secretary BRUCKER. Can I just add one word. We may have given a wrong impression here. The request of NASA does not even have to go through me. It can go directly to the Army Ballistic Missile Agency and save redtape.

Mr. ANFUSO. That is very fine. Thank you, Mr. Secretary.

Now, General Barclay, what are the advantages of utilizing the so-called arsenal system for military missile development over the industrial system?

General BARCLAY. Mr. Congressman, we feel that it is an inseparable obligation of those of us in the service to do two things with respect to the development of our weapons.

First, we must insure that the soldier in the field gets the best possible weapons which our engineering, our science, and our technology can produce.

Secondly, we feel that we owe to the taxpayer the obligation to assure that he gets the maximum benefit for each of his dollars which are spent in our national defense. To assure that we can meet those two objectives and obligations, we must have within our own organization and within what I think is erroneously called the arsenal concept, and should more correctly be called the engineering concept, we must retain capable people who are able to evaluate the product of our contractors and the people who do our development work and who can determine that we are paying a fair price for what we get and that the soldier will get the best weapon which we can conceivably develop for him.

Mr. ANFUSO. Now, lastly, can you think of any disadvantages?

General BARCLAY. There are probably disadvantages from the commercial aspect of people who would like to take over the supervision of our weapons systems but whom we feel cannot do so with the objectivity which is necessary to carry out our responsibilities.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Mitchell, do you have a question there?

Mr. MITCHELL. I will be very brief.

The CHAIRMAN. The Chair plans to recess until 2:30. We have witnesses in executive session that are very important. So after this we will adjourn until 2:30.

Mr. MITCHELL. I will be very brief, Mr. Chairman.

Mr. Secretary, as a matter of information, the projects assigned to you military-wise come from ARPA, is that correct?

Secretary BRUCKER. Yes, the military projects come through ARPA.

Mr. MITCHELL. The civilian space projects are designated by NASA?

Secretary BRUCKER. That is correct.

Mr. MITCHELL. Now you described—and I think most graphically—how this operated by saying it was interlocking; you said there was a free flow of information, a daily exchange between your projects that are designated by ARPA and those designated by NASA.

What I would like to know is, Is there any interexchange of information, that is, what you learn on an ARPA project, is NASA so advised of this advance?

Secretary BRUCKER. Yes, I meant to imply that, sir, that NASA gets the benefit of it and ARPA likewise gets the benefit of the other. With both it is an interlocking relationship, reciprocal, and I would like to have General Barclay give the word on that one.

General BARCLAY. Yes. As an example of the coordination that takes place between ARPA and NASA, on our Juno V booster unit which was assigned as an ARPA project, the NASA agency has followed that very closely. They have been sitting in on our technical meetings and they are contemplating application of that same booster to some of the projects being undertaken by NASA.

Mr. MITCHELL. Thank you very much.

The CHAIRMAN. Thank you very much.

Mr. Secretary, unless you have a further statement, the committee wants to thank you very much for being here.

Secretary BRUCKER. Mr. Chairman, I do not want to be facetious, but the question was asked about mythology and Juno.

Mr. MILLER. Aerospace was the mythology.

Secretary BRUCKER. I would like to say Juno is reputed to have been the wife of Jupiter and Jupiter is pretty closely associated with the Army.

The CHAIRMAN. That is well said, Mr. Secretary. We want to thank you very much for coming here and helping the committee, and General Lemnitzer for being here, and General Barclay for being here also. We appreciate your assistance and we do need all of the help we can get. This committee is a new committee, it is conscientious and earnest in its endeavors, and we are going to make a good record for the committee.

Now unless there is further business, we will adjourn until 2:30. It is not necessary for you gentlemen to come back unless you so desire. The 2:30 session will be executive session, not open session.

Secretary BRUCKER. Mr. Chairman, may I just say one word?

The CHAIRMAN. Surely.

Secretary BRUCKER. I am very happy to learn that you, sir, and some of the members of the committee have accepted our invitation to go to the Redstone Arsenal to see the work that is done there next week. I welcome this visit. I want to let you know that this is very pleasing, not only to the Army but to everybody, to know that you would take the interest, and I think others who have not indicated their willingness to go will think it over or hear about it, because we like to have you people see what is going on down there.

The CHAIRMAN. Mr. Ducander, did you want to make a statement on that?

Mr. DUCANDER. I would like to find out from the members who are planning to go.

The CHAIRMAN. When do you plan to leave and when will you get the committee back?

Mr. DUCANDER. We will leave at 2 o'clock p.m. from Bolling Air Force Base on Wednesday, the 11th, go to Cape Canaveral and spend the night and the next day until 4 p.m.; leave there and go to Redstone where we will spend Thursday night and all day Friday and Friday night and until noon on Saturday; return to Washington at about 4 o'clock in the afternoon, Saturday afternoon, the 14th.

I would like to find out from the members here who would like to go. I will call the roll.

Mr. Brooks.

The CHAIRMAN. Yes.

Mr. DUCANDER. Mr. Anfuso.

Mr. ANFUSO. Yes.

Mr. DUCANDER. Mr. Mitchell.

Mr. MITCHELL. No.

Mr. DUCANDER. Mr. Hall.

Mr. HALL. Yes.

Mr. DUCANDER. Mr Hechler.

Mr. HECHLER. Yes.

Mr. DUCANDER. Mr. Daddario.

Mr. DADDARIO. I will have to check the Saturday date.

Mr. DUCANDER. We will check with you later.

Mr. King.

Mr. KING. Yes.

Mr. DUCANDER. Mr. Roush.

Mr. ROUSH. Yes.

Mr. DUCANDER. Mr. Fulton.

Mr. FULTON. Yes.

Mr. DUCANDER. We will check the offices of those who are not here.

The CHAIRMAN. We want to thank you. We will accept your invitation. I hope all of the committee will go.

(Whereupon, at 12:28 p.m., the hearing recessed, to reconvene at 2:30 p.m., the same day.)

AFTERNOON SESSION—EXECUTIVE SESSION

The committee met in executive session at 2:30 p.m. in the caucus room, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will come to order. These proceedings are in executive session.

Mr. Ducander, has the committee room been cleared?

Mr. DUCANDER. As well as we can clear it, sir, except for the people back there.

[All were subsequently cleared out.]

The CHAIRMAN. I would suggest this, gentlemen. I do not want to insist on it, but it would be a little easier for everyone to hear if you would come down here. We are short of Republicans; can we temporarily help them out.

Now, Dr. von Braun, would you come up. You are the prime witness at this hearing and we have scheduled you for this particular hour, because we know it is difficult for you to get up here and local witnesses sometimes we can hear later on. We are pleased to have you again before this committee.

The people of the United States think you are doing great work in this respect and we consider you the outstanding authority on missiles.

Now do you have a prepared statement, Doctor?

STATEMENT OF DR. WERNHER VON BRAUN, DIRECTOR, DEVELOPMENT OPERATIONS DIVISION, U.S. ARMY BALLISTIC MISSILE AGENCY

Dr. VON BRAUN. No, sir; I do not. I was told that you wanted to have a little introduction to the general problems of space flight and I have brought a few slides along. We have set up a projector and screen.

The CHAIRMAN. Suppose you take over and proceed just as you wish to do and make it as informal as possible.

Dr. VON BRAUN. Right, sir. How much time will you give me for this? Twenty minutes?

The CHAIRMAN. I think we are safe in saying about an hour, from 40 minutes to an hour. We will give you any amount of time. The committee wants to hear you in extended session, but the trouble is there is at least one rollcall and maybe two rollcalls coming up this afternoon and we would not want that to interrupt you in your testimony.

Dr. VON BRAUN. What I had prepared here is a very informal talk involving, I think, 18 or 19 slides, lantern slides which I have selected to familiarize the committee with the fundamental problems involved in all major areas of space flight. I will keep it as unscientific as possible.

Can you hear me if I stand here?

The CHAIRMAN. Yes, sir; if you speak slowly.

Dr. von Braun. This first picture shows the fundamental idea behind the meteorological satellite, a satellite designed to keep us informed about the weather all over the world. Meteorologists believe that the one factor that influences the weather on the Earth more than anything else is the cloud coverage.

Now there are some areas of the Earth covered with clouds whereas others are clear. Those clouds reflect the sunlight permitting only a small portion of the Sun's radiation to get down to the ground whereas the rest is reflected back into outer space. So a cloud as seen from above, as you all know from riding airliners, looks very bright, whereas underneath it is dark.

Now, the distribution of the cloud coverage of the earth, therefore, controls the weather. But, unfortunately, since 70 percent of the earth's surface is covered by water and even the land areas are partly thinly populated and not all covered with weather observation stations, we know very little about the total cloud coverage of the earth, its geographical location, and how it changes.

Now, with one simple satellite going around the earth, say, 16 times a day and equipped with a television camera relaying information continuously to the ground, we can provide this information. With several such weather satellites, of course, we can virtually retain continuous uninterrupted knowledge as to change in this overcast. Meteorologists believe that with such satellites it would be possible to really dramatically improve our capability of forecasting the weather.

The military indications, as well as the advantages accruing out of this for agriculture, and the tourist trade, would be rather obvious.

This slide depicts the satellite above the surface of the earth, discerning the cloud coverage and the clear areas.

The next slide, please.

This next slide shows another application of satellites which we all feel has a tremendous commercial, as well as military, importance. It is a system consisting of three satellites spaced 120° apart in one orbit, at a distance from the earth of approximately 22,000 miles. This orbit at this tremendous altitude of 22,000 miles, would go around the earth at the plane of the Equator and at this altitude the period of revolution of each of these three satellites happens to be exactly 24 hours. With these satellites flying in the direction of the earth's rotation, that is, from west to east, each will be stationary over a certain point on the earth's Equator.

Now, in view of the distance of this orbit from the surface of the earth, each of these three satellites will be able to see the other two. They will not be obstructed by the earth because the earth is too far away. Also, every point on earth between the North Pole and the South Pole will always see at least one of these satellites. Over the Equator it might be right at the zenith, or there, or there [indicating]. Over the North Pole it will be right at the horizon, the same at the South Pole; but at any point in between every point on earth will be in optical line-of-sight contact with at least one of these three satellites. For this reason it is possible to establish a radio link with line-of-sight radio from a point on the earth up to the satellite, from this satellite to another satellite, and from this satellite to another point on the earth.

Now, you all know that the spectrum of radio frequency is so overcrowded that it is virtually impossible to add any more communication links to the existing radio spectrum. In the shortwave region where the waves do not bend around the earth and follow the curvature of the earth, but where you can communicate only with line-of-sight contact, the spectrum has almost unlimited capability of taking on more messages, simply because you can stack the frequencies tighter. For that reason a system of research satellites opens entirely new avenues for worldwide communications.

It can be used for worldwide radio, worldwide television hookups, worldwide facsimile, messages, wires, telegrams, everything. The traffic volume handling capability of such a system depends only on the amount of weight that we are willing to install here, and it is clear—investigations prove this without any doubt—that a satellite weighing between 5,000 and 10,000 pounds going around at this altitude, a system of three satellites would handle all of the mail volume of the entire earth.

Now the price to set up such a system will be negligible, or almost negligible in view of the fact that the vehicle cost to carry it up there can be amortized against many other projects also, if you compare it with the price of, say, a submarine transatlantic cable which, of course, has only a very limited volume capacity. I believe that such a satellite system, which, incidentally, is under active development today in the United States, can be a tremendous moneymaker too and may actually provide the sources of revenue to finance the rest of our space programs.

Just imagine if you could charge a penny a word for this kind of service. I would like to mention that aside from the commercial possibilities of this system, it has tremendous military applications and it is for this reason that the present 24-hour satellite system—communications satellite system—is being sponsored by the military services.

It has been taken over by ARPA and the immediate objective at the moment is to provide the Strategic Air Command of the Air Force the Submarine Command of the Navy and the Army commands, Tactical Army commands with communication channels.

Can I have the next slide, please.

The next area that I would like to cover in my presentation here is the problem of lunar problems and, more generally speaking, the exploration of the moon. You know that the United States has tried several times now with the Pioneer probes to send a sample, a so-called space probe, past the moon. Unfortunately only two of our probes have worked fairly successfully, but none of them have gotten there. Both of the Air Force's Pioneer I, and the Army's Pioneer III fell short of the velocity necessary, and went only about a third of the way to the moon. With 3 percent more velocity, the moon's vicinity could have been attained. The Russian's Lunik actually did the trick.

This slide shows the flight path which we planned for our Pioneer III space probe and it is planned again for our forthcoming Pioneer space probe.

Transport time of 34 hours has been figured. With a little more velocity we can bring this time down by several hours and by not

going quite as high a velocity we can still transfer a rocket to the moon with a longer transfer time, up to a 100 hours, but this particular flight time of 34 hours was appealing to us because a flight to the moon would be close to the moon at the time that our tracking station in California would have the moon in optical line of sight.

The CHAIRMAN. I am wondering if you stood up a little closer you could still point and we could hear you more effectively and it would not be as hard on you. If not, you can resume your position.

Dr. VON BRAUN. Suppose I take the microphone and pull it as far as I can.

The CHAIRMAN. You could have somebody else do the pointing for you.

Dr. VON BRAUN. These early lunar probes, of course, had the sole objective of going toward the moon in a one-way trip. The moment we consider putting people into such rockets it will be necessary to bring them back.

The simplest type of a manned lunar expedition will be a trip around the moon not involving a landing on the moon with an ensuing return flight in the atmosphere. This is depicted in the next picture.

You see the earth here and over on the right corner—would you move the slide a little bit—there is the moon. So here you see the trip out to the moon and if you time this undertaking properly, the moon will be at the remotest point when the rocket gets there and the rocket will then simply fall back toward the earth and its velocity will increase again on the way down. It will tangentially sweep into the atmosphere and then the most harassing part of the trip begins; to decelerate the rocket from its initial 25,000 miles an hour velocity at which we enter the atmosphere, down to subsonic speed and landing. The trip around the moon not involving a landing on the moon is much simpler than a landing on the moon simply because it requires two fewer maneuvers. There will be no landing on the moon and no departure from the moon. There will simply be a departure from the earth, building up the necessary speed to go out to the moon—a correction maneuver involving very little propellant supply to place the rocket into the right position to get back to the atmosphere at the right angle.

A voyage to the moon involving a landing and takeoff from the moon is far more involved, because all of the propellent that is required for the landing on the moon and the departure from the moon must be brought up there to begin with. Therefore, the initial rocket that takes off from the earth will be much larger.

May I have the next slide, please.

This slide shows what such a rocket might look like. You see it there in the right corner of that lunar landscape. Note that the rocket is not streamlined. There is no need for aerodynamic streamlining for outer space rocketships simply because there is no atmosphere. The way to build such ships would be that the tanks and the crew in a cell and the rocket engines will be freighted up to the orbit where all of the parts are put together, then the rocketship is fueled and it takes off from the orbit around the earth and returns to that orbit around the earth again. It will never get into the atmosphere. Return to the atmosphere will be done with a different type of vehicle. So, for a voyage to the moon and back, we will use for the first time

deep spaceships, which is an entirely different breed of cat from what we are used to.

May I have the next slide, please.

I mentioned that for deep space operations of a more ambitious nature—that is, round trip to the moon and even to the planets—it will become necessary to separate the undertaking into two different phases. We will have one kind of vehicle solely designed to carry people and cargo into an orbit around the earth. In this orbit the people brought up there will take the cargo out of the other ships and assemble it to build one of these nonstreamlined deep spaceships which are solely designed for the voyage to the moon or other planets but not for travel in the atmosphere. The vehicle you see on this slide is designed for the first part of the mission, to get people and/or cargo up to the orbit. It will be a multistage rocket.

The first stage will go up to about that first platform [indicating]. Then comes the second stage to the next platform and the wing unit sitting on top of it will be the third stage. Only the third stage will get up into the orbit and only the third stage has the capability of landing again at the launching site.

The next slide shows what the third stage or top stage will look like when it lands again at the airport. It will be essentially a supersonic airplane, and upon its approach it will put its flaps out and land like a normal aircraft. Not all of these orbital supply rockets will have wings, however.

If no people are involved, you can use a nonwing top stage designed to remain in orbit and maybe even serve as tankage for a deep spaceship. It will have no return capability and can therefore bring much more useful payload to the orbit because it is not mortgaged with heavy wings, landing gear, pressurized cabins, and the like. But the basic vehicle will be the same. There will be the same first and second stages. So the typical orbital supply vehicle will be a big first and second stage on which alternately either a oneway top stage can be added for the sole purpose of carrying supplies or fuel to the orbit, or a manned version that has return capability but cannot carry as much payload.

May I have the next slide, please.

Aside from the vehicular aspect, space flight involves a number of medical problems. One is the high acceleration. To build up a speed of say 25,000 miles which is necessary to go from here to the moon, we have to provide a very substantial acceleration for several minutes simply to get that speed.

Now any rocket when taking off from the ground will be heavy and for that reason the initial acceleration will be quite low. It may be less than 1 g.—on top of the 1 g. we are subjected to as we walk around the earth. As the missile consumes its fuel it becomes lighter and the thrust remains constant and the acceleration will go up and toward the end of the burning time of each stage the acceleration may be as high as six or seven g.'s.

Of course, once a stage is dropped and the next stage takes over it begins again at a lower acceleration, so the acceleration pattern will follow such a curve, a sawtooth curve. Every time the acceleration goes up it drops down again and goes up again.

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Now to train the crews on how to take these accelerations and how to operate and function efficiently under these high accelerations, centrifuges are in use. We use the centrifuges simply to whirl the man around and you can present him with all kinds of tasks to perform under the acceleration. Such tasks may be simple in nature. For example, you can ask the man to make a little sketch and then see how that sketch deteriorates as the acceleration goes up and the thing spins faster, but you can also cast what we call "synthetic disasters" on his dashboard which are created with a computer on the ground and which create on his dashboard the impression like something in the rocketship he seems to be flying went wrong. Then under 6 g. acceleration the man has to use the right judgment and push the right buttons to remedy the source of trouble.

All this, of course, is a synthetic thing, but it is very suited to analyze the proficiency of the man under these conditions. This procedure is in wide use today.

The next slide deals with an entirely different problem. You see a little white mouse here sitting in a glass jar and this laboratory assistant is watching him. Over to the right side is a gage which measures the airflow that is continuously being pumped through this jar.

The purpose of this experiment is to investigate what biologists call the problem of life in the pen. It simply means what happens when you enclose a biological specimen, for example, a mouse, into a limited confinement over a long period of time, say weeks or months so that the mouse must continuously breathe again the air it has been exhaling, when the mouse eats in this thing, performs its sanitary functions and everything, what happens to the air. Is it possible to treat the air chemically over a long period of time so that there will be no actual poisoning due to the fact that some poisons accrue in that air circuit which will ultimately kill the mouse.

Just to give you an inkling of this problem here in a normal household it is known that about 29 different toxic agents are formed in routine operations. For example, when you fry an egg and some of the egg white is burned in the frying pan, a very potent poison called acrolein is formed. If this acrolein were formed in this environment and the man would breathe it over and over again 24 hours a day, 7 days a week, he would die from the acrolein from the frying of one egg.

In a normal household there is no problem, because if you burned an egg, the housewife would cough, open the window, and the poison would go out. Of course with suitable filters it is possible to take all of these poisons and toxic, offensive odors out of the air stream, but you have to know how to do it.

The submarine *Nautilus* is confronted with very much the same problem. They have a crew of almost 120 people in there. They have made long cruises, and I think they still have a problem that after 30 days people just hope for the day when the conning tower will be opened and some fresh sea air get in, despite all of the chemical cleansing agents they have. So this is the problem of life in the pen.

The next slide deals with the problem of vacuum. I mentioned for deep-space operations it will be necessary to assemble special deep-space rocketships out of parts shipped up there by orbit and supply rockets. This means that crew members and fitters will have to leave the rocketship to perform these assembly and fitting operations. Since

there is a vacuum outside they have to be properly clad so their bodies would not explode under the internal pressure. One answer to this problem is the full pressure suit. * * *

For fitting and assembly operation in the orbit, the question arises, however, whether such a unit tailored after the human frame is really what is needed. This man is not only encased in a pressurized shell, his torso and the rest of his body, but even his hands stick in pressurized gloves. Each finger is pressurized, and the question is, can a man really perform a complicated assembly job in this kind of garment?

The answer to this question may be the so-called bottle suit which is shown on the next picture.

Here we have an entirely different idea. The man is no longer encased in a pressure suit fashioned after his body. He, rather, sits in a rigid bottle. It almost looks like a Coke bottle, and in that top, that dome, you see his head. Within this bottle he is strapped to a board, and around his chest is a panel with manipulators into which he can stick his hands.

There are seven arms protruding from this unit. You can see two of them. These are artificial arms [indicating]. He can operate these arms with manipulators from the inside, and by moving his fingers and twisting the manipulators, he can operate the tool which is attached to the end of the arm.

You probably have seen these manipulators used in the atomic energy projects, where people have to pour the contents of one bottle into another bottle with a radioactive fluid which they are not supposed to touch. Well, the idea is the same. In a way there is a similarity between this concept and the artificial arm of an amputee. The advantage of this concept over the one shown in the previous picture is that you really provide the man with tools at the business end of these artificial arms. What you need there is really not five fingers, but what you need is a drill or pliers or a device to rivet something or to weld something, and you can provide all kinds of special attachments to these arms in accordance with the job at hand.

Of course, in order to maneuver himself around in space, the total suit must also have a capability of positioning itself in the right attitude. So the man will have a joy stick similar to that used in airplanes which, by pushing down, will create an operation of gyroscopes, so the suit moves over, like this [indicating]. He can control his attitude in this way.

There is also a built-in rocket plant which can exert a thrust of a few pounds in either the downward or upward direction along the longitudinal axis of the suit, and from this way he can move away from the ship and move back to the ship.

Needless to say, there will be built-in walkie-talkies and built-in air-conditioners and all kinds of things in this bottle suit.

An amusing aspect, as it turns out, one of the most tricky problems in these pressure suits is a man can't even scratch himself. When you are completely encased in a pressurized suit, you can't scratch yourself, blow your nose, things like this. In this suit you can. For the well-being of the man and his proficiency in these little things, this may be important. A man can even eat a sandwich in this bottle.

So much for the biological aspect.

Now, may I have the next slide?

We now come to the concept of outer space in more general terms.

Outer space is one of the most frequently used words and one of the most abused names these days, so it might be proper first to try to define it.

I don't know a better definition than the one my good friend, Jim Van Allen coined the other day when he said the definition of outer space was that outer space is the hole we are in. In other words, surrounding the Earth is outer space, and we are right there in it.

On this picture you see the Sun on the left side, with the planets. You begin with Mercury, Venus, and then comes Earth. That little rather insignificant thing there is the Earth. Then comes Mars, and then comes the big one, Jupiter, Saturn, and then comes Uranus, Neptune, and, way out there, Pluto.

Our first objective, of course, in outer space, after we have established satellites, is to go to the Moon. The Moon is that tiny little speck next to the Earth that goes around the Earth.

I would also like to point out that the relative distances, of course, are entirely out of proportion. Just the sequence is right.

Now, we have seen by a previous picture what it takes to go from the Earth to the Moon. The moment we want to go from the Earth to another planet, the situation becomes quite different, because both the Earth and your target planet are going around the Sun, and for that reason you cannot go directly as a crow flies but you have to take into account that we have already an initial speed, namely the speed of the Earth as we depart from the Earth.

Now, the next chart shows this in a little more detail. You see the Sun in the middle of this thing, and a little bit to the left of the Sun, at E–1, is the Earth.

Now, the Earth goes around the Sun in a counterclockwise direction. Now, so does Mars, which is shown as the red planet in the outer orbit. To go from the Earth to Mars in a most economical flight path now requires the following: You have to impart the speed to the rocket in the direction of the Earth's own orbital motion around the Sun, which is a counterclockwise direction, and if that speed is high enough, it will bring the rocket out in this elliptical transfer flight path which will intercept Mars at M–2, 180° later.

Why does a rocket go through this elliptical flight path?

Well, it is easy to see. At E–1, the Earth goes through a circular orbit, and the circular orbit is simply defined by the condition that the Earth has a sufficient horizontal velocity so that the centrifugal force exactly compensates the Earth's weight in the gravitational field of the Sun, so the Earth just goes around in nearly circular orbit.

Now, if you could accelerate the entire Earth by approximately 1 mile per second over and above the 90 miles per second that the Earth is doing already, then the Earth, itself, would also go into that ellipse, because now with the distance of the Sun at first at least remaining constant, the centrifugal forces would increase; they would overcome the gravitational field of the Sun, and as a result the Earth would further recede from the Sun. It would coast upward in that ellipse and reach the point M–2, the highest point of that ellipse with respect to the gravitational field of the Sun. This we call the aphelion of this ellipse. If it were left to continue, it would follow

through the second leg of this ellipse and go back to E–1 and go down to the lower orbit of the Earth again and remain in this eccentric ellipse forever.

Now, we cannot do this with the whole Earth, and we won't do it, but we can take a portion of the Earth, for example, a little rocket ship, and fire it up in the direction so that when it leaves the gravitational field of the Earth it is flying exactly forward in the same direction as the Earth's own orbital motion around the Sun. In this case only the rocket ship goes in that ellipse.

Now, we can time the whole business in such fashion that when we get to M–2, to that point down there, that the planet Mars is also there, so that we just don't touch the orbit of Mars but make sure that Mars is really there for a rendezvous.

Now, you can figure out this is only possible if Mars is at the point M–1 when you take off at E–1, which means it must be 44° as seen from the Sun, angularly ahead of the Earth. This is simply so because it takes Mars 261 days to go from M–1 to M–2, and it takes the rocket ships also 261 days to get from E–1 to M–2. So this is the timing aspect of the whole thing.

Now, let me show on the next slide what that means as far as the departure from the Earth is concerned.

You see here the Earth, and I mentioned that such trips will be carried out not from the surface of the Earth but from an orbit around the Earth, so you see the Earth here, and that ring surrounding the Earth is the orbit on which we depart.

Now, at this point we can fire the rocket and then follow a powered path that terminates at the point of cutoff. Here the maximum speed is reached to go to Mars, and from there on the free coasting flight begins, unpowered.

The rocket follows this so-called departure hyperbolic escape leg and will ultimately fly to the right, which is parallel to the direction of the Earth's orbital motion around the Sun. This is how we get into the orbit.

Now, 260 days later the rocket will then in that solar half-ellipse approach Mars, and this we see on the next slide—first, this is the power maneuver. This is what the two rocket ships would look like that depart from the Earth in that power maneuver which built up the sufficient speed to escape from the gravitational field of the Earth and enter that solar ellipse.

Now, 260 days later—next slide please—the ship will approach Mars, and here the situation is as follows:

Mars moves through its own orbit at approximately 11 miles per second. It is a little slower than the Earth, but the ship that has coasted out there to Mars has lost velocity because it has been going uphill in the gravitational field of the Sun all of the time, so it is even slower than the 11 miles per second, approximately down to 10 miles per second. So as it gets to Mars, Mars will now overhaul the ship from the rear, and as seen from Mars, the ship will fall into the Mars gravitational field. If we position it properly at the beginning, it will fall in this so-called approach leg, the capture hyperbola, and at the point R–T, we will decelerate the speed and induce the ship into the orbit around Mars, and that is where our nonstreamlined ship

will remain for the period of exploration of Mars, itself, until it will depart to Earth again from that orbit around Mars.

In this fashion we need not carry the return craft. We just park it in the oribit, and then take the special vehicle.

The next picture shows what such an approach to Mars would look like. The ships are sweeping into this hyperbolic flight, tangentially past the surface of Mars, and they will then fire the rockets, using them as brakes, and introduce themselves into the hyperbolic orbit around Mars.

You see there is a big ship with wings on the top and an apparently smaller one farther down. This ship in the foreground is a one-way vehicle. It is designed to fly only from an orbit around the Earth to this orbit around Mars. What arrives there is only a winged vehicle, capable of landing on the surface of Mars and departing from the surface of Mars again and returning to the orbit. The other ship, the one underneath, has no Mars landing capability. It is a round trip ship. It has all of the fuel it takes to go out to Mars and back to the Earth, but it has no capability of landing.

There is some advantage of breaking up such trips into two such vehicles, and fundamentally the idea is very much the same that you would use in taking a fleet tanker along with the Navy. When you have a battleship and the battleship carries a lot of other weight and you want to extend its radius, you can take a fleet tanker along and when the battleship is dry, the fleet tanker comes alongside and transfers its fuel to the battleship, and then the fleet tanker either goes to some nearby port to get enough fuel to go home or, in theory, you could even abandon it. But even by abandoning it, you would stretch the range of the battleship.

We actually abandon the one-way ship in space flight. That seems to be far more economical than to try to bring it back.

So by breaking a trip down into two ships, one for the one-way trip, that brings plenty of useful payload to your target, the planet, and the other equipped with enough fuel for the round trip but no payload. You can have your cake and eat it, too. You have enough fuel to bring you home and at the same time you can bring substantial payloads, hundreds of tons, to other planets.

So this is the idea.

The next picture shows the winged vehicle after it has landed on the surface of Mars. Note that its front portion has been separated from the winged after portion and has been erected. It is this front portion which carries enough fuel to go back to the orbit around Mars.

Fortunately, due to the fact that Mars is a much smaller planet than the Earth, it requires much less propellant to get from the surface of Mars to orbit around Mars, and this can be done with a one-stage vehicle.

There are also ground vehicles brought along. You see them to the left. This is something science writers very often overlook. There is no point in sending some people to Mars unless you give them some equipment along to really do some useful work there and to conduct some research.

One of the most important things they will need is housing, so you see that little pressurized tent down there in the valley, this hemi-

spherical thing. It is like a plastic dome used on the DEW line, with a radio station and everything.

There is also ground transportation in the form of track-laying vehicles, with a pressurized compartment on top, which will be used to drive around on Mars.

It would be advantageous of course to have nuclear-powered vehicles, but they can even be driven with chemical energy.

The return trip will be carried out by the crew members. The ground equipment will be abandoned, and the crew will get into the rocket and fly back to the orbit, where that other ship, the nonwinged, round-trip ship, has been circling, and they will go back to the earth, in that other ship. In fact, they will not go back all the way to the surface of the earth but only return to the orbit around the earth, and from there one of these winged, upper stages that I showed in one of the previous slides, used in the orbital supply operation, will provide the final portion of the trip back to the surface of the earth.

This slide here shows quite an interesting aspect. Such a Mars ship as used in this particular scheme would weigh 1,870 tons when departing from the orbit of the earth. After arrival in the Mars orbit, it will be down to 218 tons. Now, the one-way ship—that weight will be abandoned, and it will be a practical, useful payload, that is in the second column, whereas, the round-trip ship will still weigh 237 tons when it returns, mainly because the people and some cargo have been returned to the main ship, and finally when it returns to the earth, the weight is down to 38 tons.

So you see you take off with a heavy, big vehicle, and what comes back to earth is the bare minimum of what is necessary to bring the men back alive.

All of the food has been eaten up, the air has been used up, the fuel has been burned up, and there is virtually nothing but the passengers and the empty cabin.

This ends my presentation, sir.

The CHAIRMAN. May I ask you a question, Doctor?

Why do you need those wings on that plane out there in space?

Dr. VON BRAUN. You don't need it in space. You need it in order to land on Mars. The planet Mars has an atmosphere which is not quite as dense as ours but it is sufficient to permit an aerodynamic landing on the surface of Mars.

The CHAIRMAN. You would need that as you reenter atmosphere?

Dr. VON BRAUN. Yes; you would finally glide down on the surface of Mars and land on skids on the surface of Mars.

The CHAIRMAN. Are there any questions?

Mr. FULTON. We want to compliment you, Doctor, for your fine work, and we in America feel that you are one of our best assets.

I remember when you were before the select committee that you said that you could make a moon shot, and I might say to you you were the one who put the first American shot in orbit, and it was done 84 days after you said you could.

I think that is a real accomplishment and should be in the record.

There is one question, though, that I would like to have you explain a little, and that is temperature variation between the sun-reflecting side and the shady side, either the space suit or the spaceship, how

do you compensate for the difference in temperature, which must be tremendous where there is no atmosphere.

Dr. VON BRAUN. Well, it actually is a little more complicated than I can present here. But to put it in very simple terms, when you expose a black surface to the sun, it heats up. When you expose a white surface to the sun, it will reflect the sunlight. So if you have a sphere, a spherical body, which you paint black on one half and white on the other, simply by rotating it around, you can adjust any temperature you want. If you expose the entire black side to the sun, it gets very hot, because it doesn't reflect the heat. If you turn it around, the white reflects the sunlight, and the black reflects the heat that it has out into outer space, and it cools down. By just rotating it properly, you can adjust the temperature.

Mr. FULTON. In a space suit you couldn't have it so the rays could penetrate it through a transparent——

Dr. VON BRAUN. You mean in the dome?

Mr. FULTON. In the headpiece.

Dr. VON BRAUN. Yes; he will have to have his head protected, and it may be necessary to use tinted glass and glass that is properly prepared, so that it is transparent for him and yet reflects, for example, the heat waves, the infrared radiation from the sun.

Mr. FULTON. * * *

Dr. VON BRAUN. * * *

Mr. FULTON. * * *

Mr. FULTON. On this next Army shot, do you have a capability of reasonably getting within the vicinity of the moon, so that the two extra Air Force shots, that is, the payload, can be diverted to other purposes?

Dr. VON BRAUN. Sir, the main objective of our experimentation is still the exploration of the radiation belt around the earth. Our last firing in this respect, although it was a failure as far as reaching the moon, was very successful because it went even twice through that area and supplied us with very valuable data. We are actually after this objective again. Hitting the moon or getting close to the moon is only the secondary objective. The importance lies mainly in the psychological effects.

Mr. FULTON. Did you have infrared equipment aboard the last rocket?

Dr. VON BRAUN. Yes, sir.

Mr. FULTON. What were the results of that as regards military security? Did it perform well? On the infrared equipment, was our tracking—were we able to monitor it so we could tell how it worked?

Dr. VON BRAUN. As you know, on the last firing we were not successful simply because we did not get close enough to the moon to even use it.

Mr. FULTON. Finally, and may I say this, on your chart, I believe that when the missile approaches Mars, it moves to begin with, in a parabola because there is no forward or retroforce, but when there is a force applied that is either forward or retro, then it moves in a hyperbola. So when you move into the gravitational force of Mars, it would be a parabola?

Dr. VON BRAUN. If there is no forward force, that is right.

Mr. FULTON. So there your chart was wrong?

Dr. VON BRAUN. In this case it would be a hyperbola. It would be a parabola if there were not that initial force.

Mr. FULTON. Thank you.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. Doctor, what is the Army's further ability to participate in space exploration, still carrying on its present program with its missiles?

Dr. VON BRAUN. Sir, we have a great number of assignments, both from ARPA and NASA, in the space area, very challenging assignments, and we are doing our best to meet them.

Mr. MILLER. Do you have the capability of meeting them?

Dr. VON BRAUN. Yes; and we have the assignments, too.

If you want me to be specific, I can enumerate these projects that we are conducting.

For ARPA, our most important mission is the development of 1½ million pound-thrust booster, using a cluster of existing rocket engines. These are improved Jupiter engines. This booster is designed to be the biggest booster that would be available for the years to come. * * * Its main objective for the time being is to serve as a carrier vehicle for a military 24-hour communications satellite, along the lines of one of my early charts.

Mr. MILLER. Well, those communications satellites I should think would be one of the most important, high-priority pieces in this field, because from them we can get the information to go into it further. Isn't that correct?

Dr. VON BRAUN. Yes, sir; that is correct.

ARPA has given us this project with a high priority, but I think we could speed up this operation if more funds could be made available, and ARPA is very well aware of this and has actually requested supplementary funds and would like to give us more funds if they, themselves, could lay their hands on more money.

Mr. FULTON. How much money do you want?

Mr. MILLER. Do you feel, Doctor, that this is the all-important project, or would you give it the highest type of priority?

Dr. VON BRAUN. Sir, I would, because I think all other projects that either we or the Air Force are pursuing are essentially utilizing existing ballistic missiles for space missions. All other space missiles are fallout at the moment of our military missile program. All this experimentation is necessary and valuable, but it is all based on using existing military missiles modified for space flight.

However, this is the first second-generation space vehicle designed for this purpose.

Mr. MILLER. Then if we are going to make real progress in this field and to stay ahead in the field once we catch up, this particular project of getting up these fixed satellites——

Dr. VON BRAUN. You can look at it this way—

Mr. MILLER (continuing). Is all-important?

Dr. VON BRAUN. * * *

Mr. MILLER. Now, the money is just one of the elements that enter into this thing, as far as I can sense it, because you can do just so much so fast. You can't buy information.

Dr. VON BRAUN. That is correct.

Mr. MILLER. There is no place you can go in and buy it. But you need it. To shove this particular project to the ultimate, you would need more money?

Dr. VON BRAUN. Yes, sir. Specifically, I think we are not confronted with any fundamental barriers in this project, barriers of knowledge, where we have to wait for breakthroughs. This is a very straightforward engineering project. Right now it is funded at a rockbottom minimum amount. We are doing our best to do it with this amount of money, but the handicap is that we have to assign most of the hardware we buy for the money we have for flight testing and too little remains for good ground testing jobs.

It has been our experience and everybody else's experience in this field that you can buy assurance by putting more hardware aside, components aside, in the early development stage, and subject that to very thorough ground testing so that you have highly reliable and well-proven components by the time you go into the early flight testing phase.

Our disadvantage right now is that practically all of the hardware we buy, with very little exception, must be assigned to flying hardware already, because we have promised we are going to meet a schedule, and there is too little money to buy enough, and so we have to take tremendous risks.

Mr. FULTON. How much more money do you want, with the gentleman's permission, for next year? How much is it?

Dr. VON BRAUN. Well, specifically, we have requested $40 million additional appropriation for fiscal year 1959 for this project, and $100 million additional in fiscal 1960.

Mr. FULTON. Well, you have one vote here.

Mr. MILLER. Mr. Chairman.

The CHAIRMAN. Let me say to the committee that my office just called to tell me they are getting ready to vote on a question of limiting the draft to 2 years instead of 4 years, so I am afraid that we are going to be called at any moment now.

Now, in order to get around to some of the members of the committee, the Chair is going to suggest that we limit our questions to one or two questions, so we can get around to them.

I promised to recognize Mr. Hall.

I might say I can't see them down there either, the way we are set up in there. I can't see who wants to be recognized.

Mr. MILLER. May I say in closing that I thank the doctor for what he has brought forth, and I think that is the most important testimony that we have had in this whole thing. It is concrete, and I am very happy to have it.

The CHAIRMAN. He is a great American.

Mr. HALL. Doctor, I am David Hall, of North Carolina.* * *

Dr. VON BRAUN. * * *

Mr. HALL. * * *

Dr. VON BRAUN. * * *

Mr. HALL. Thank you, sir.

The CHAIRMAN. May I ask you a question? I haven't asked any questions. * * *

Dr. VON BRAUN. * * *

The CHAIRMAN. * * *

Dr. VON BRAUN. * * *
The CHAIRMAN. * * *
Dr. VON BRAUN. That is correct.
The CHAIRMAN. Perhaps longer?
Dr. VON BRAUN. Yes.
The CHAIRMAN. * * *
Dr. VON BRAUN. * * *
The CHAIRMAN. * * *
Dr. VON BRAUN. * * *
The CHAIRMAN. Mr. Anfuso.
Mr. ANFUSO. Dr. von Braun, I too want to congratulate you for the excellent service you are giving to our country. * * *
Dr. VON BRAUN. Yes, sir.
Mr. ANFUSO. * * *
Dr. VON BRAUN. * * *
Mr. ANFUSO. Would you give us that picture, please.
Dr. VON BRAUN. * * *
Mr. ANFUSO. * * *
Dr. VON BRAUN. * * *
Mr. ANFUSO. Some people have said that we have lost the balance of power. I wanted your opinion on that, your frank opinion.
Dr. VON BRAUN. I just do not know. I would have to have more facts.
Mr. ANFUSO. Thank you.
Mr. SISK. Mr. Chairman.
The CHAIRMAN. All right, Mr. Sisk.
Mr. SISK. Just one question, Dr. von Braun. In view of the requests for work at present on hand by your team at Redstone, do you feel that your group is being challenged and that you have a sufficient amount of work allotted to you to use your skills and the skills of the people with you to its most effective capability at the present time?
Dr. VON BRAUN. Yes, sir. Our situation is such that the total number of assignments that we have is really enough to keep us busy. On the other hand, most of the programs that we have are a little bit undernourished, so we could use more funds to do a more effective job on all of these projects, so we actually need not more work but more money.
Mr. SISK. But the objectives that you have now outlined in front of you, on behalf of NASA, and ARPA and other groups are sufficient to test to the fullest your skills and ability and scientific know-how and all you need is a little additional money here and there to facilitate and expedite the program.
Dr. VON BRAUN. Absolutely. * * *.
The CHAIRMAN. Mr. Hechler.
Mr. HECHLER. * * *.
Dr. VON BRAUN. Sir, I personally advocate a well-planned long-range space program with a little more emphasis on the word "program" and a little less emphasis on the word "crash." I think the reason that we have to crash is very often that we have no program.
Mr. HECHLER. * * *.
Dr. VON BRAUN. Sir, there are certain interim steps that must be clarified first before we feel we are ready to do this. I think in an

orderly space program the first landing on the moon should be completed after these interim steps have been completed, so it would be a logical step in the entire ladder of effort.

Mr. HECHLER. I understand. Thank you.

The CHAIRMAN. Do you have a question, sir? Mr. King.

Mr. KING. Dr. von Braun, there was a time a few years ago when it was hard to pick up a newspaper without reading an account of flying saucers. Obviously most of those cases were hallucinations and we discounted them completely, but there were a few that seemed amazingly well authenticated and documented. Do you have any opinion on that phenomenon?

Dr. VON BRAUN. Sir, I have never seen one myself but I had the opportunity to talk to an Air Force officer who was assigned to that project and who would show up every time a flying saucer had been reported and he told me that his experience was that 98 percent of all these reports could be accounted for by something. Either there was a high-flying airplane or a runaway balloon, or it was Venus, or something. There were many cases on record that made the headlines that turned out to be just plain hoaxes, where a few people got together and said we will all tell the newspapers the same story, and it took the Air Force a while to find out this whole thing was a conspiracy of a couple of fellows who tried to put a hoax across. There is about 2 percent unaccounted for, but he said after a long time in this business—the name of this officer was Colonel Sterling, he worked out of Wright Field. His personal conclusion was while he still felt they should go ahead and pursue all of these reports because you can never tell and the public demands it, and so forth, that he was not convinced that there is any evidence of extraterrestrial bodies getting in our atmosphere.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Doctor, did I understand in answer to the questions posed by the gentleman from California, Mr. Miller, that you place highest priority to the three satellites placed 120 degrees apart at 22,000 miles in orbit?

Dr. VON BRAUN. That is correct, our large booster is part of that project.

Mr. DADDARIO. * * *

Now would that not be a proper assumption?

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

Mr. DADDARIO. * * *

Dr. VON BRAUN. * * *

The CHAIRMAN. I do not want to interrupt here, but they are beginning to vote on amendments. We have no authority to sit except during general debate and I want to work with the leadership there so as not to be in session while they are voting on amendments, so if there is no objection, I think we had better adjourn. Before we do it, I want to read into the record this article taken from the local press which should be of interest to everybody in this committee:

Russia's Sputnik III will be visible here tonight if the skies are clear. The 11.8-foot, 3,000-pound satellite will pass over the Washington area at 6:48 p.m. according to the Vanguard Computing Center.

I recommend that everybody take a look at it if it is clear.

Mr. FULTON. To help Dr. von Braun, could we ask him to put into the record the total overall money he would like to go ahead with his programs for the remainder of 1959 and then for 1960, and then break it down by program, and could you also put in the record for me how you are going to make your satellites go in a circle rather than an ellipse according to Kepler's second law?

Dr. VON BRAUN. Thank you.

The CHAIRMAN. If the doctor will do it, we will be glad to have it in the record. Thank you, Doctor.

(The information referred to is as follows:)

The additional funds requested for fiscal year 1959 have been supplied since the time of the hearing.

In fiscal year 1960 an additional amount of $96 million for the Saturn program could be utilized to assure greater reliability and a better vehicle. This $96 million would be used as follows:

For details work and procurement of hardware for the upper stages of the booster, $20 million.

For engineering work on potential payloads, $9 million.

For concentrated engineering effort on all elements of the booster and the procurement of hardware for component testing in light, $48 million.

For expansion of Army Ballistic Agency test and fabrication facilities and equipment, $11 million.

For the launch facility at the Atlantic Missile Range, $7 million.

Mr. FULTON. I would like to join with general counsel of the select committee, George Feldman, Dr. Charles Sheldon of our staff, as well as Mr. Philip Yeoger, and Eilene Galloway, when we compliment you highly on your appearance and address in Amsterdam, Holland, on Saturday, August 30, 1958, when you explained to the 26 nations of the International Astronautical Federation the results obtained from the three Explorer satellite programs of the United States. We were proud to be there and hear you and to see the fine reception which every nation gave.

As a matter of fact, the eyes of the world are upon you whether you are in Alabama, Texas, or Amsterdam at the time.

Dr. VON BRAUN. Thank you.

(Whereupon, at 4:11 p.m., the committee was recessed.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Monday, February 9, 1959.

The committee met at 10 a.m., in room 356, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. The committee will please come to order.

Mr. Ducander, there is no use to call the roll. Will you check up on the attendance?

Mr. DUCANDER. I have it, sir.

Mr. FULTON. The Republicans are here.

The CHAIRMAN. Now that we are represented in a well-balanced way here, to the right and left, we will go into session.

This morning we have two witnesses, Maj. Gen. W. W. Dick, Director of Special Weapons, Office of Chief of Research and Development, and Maj. Gen. D. E. Beach, Director of Air Defense and Special Weapons, Deputy Chief of Staff for Military Operations.

Initially, as I understand it, both of these witnesses have prepared statements. The session will be open. I hope that the witnesses will let the committee stay in open session as long as possible and then when we get to a point where classified material is being received, of course, we will have to go into executive session. We will finish the open session this morning so the press won't have to wait around. But in any event let us give the press all we can conscientiously.

Now, Maj. Gen. W. W. Dick, Director of Special Weapons, Office of Chief of Research and Development. General Dick.

STATEMENT OF MAJ. GEN. W. W. DICK, JR., DIRECTOR, SPECIAL WEAPONS, OFFICE OF CHIEF OF RESEARCH AND DEVELOPMENT, U.S. ARMY

General DICK. Mr. Chairman, members of the committee, I would like to outline very briefly this morning two subjects, both of which are of vital concern to the Nation.

The first item is concerned with the Army's current and future interests in space; the second item will be the status of the anti-ICBM development program.

Space is a newly entered, largely unknown medium which transcends the exclusive interest of any service or even of the Department of Defense. Space development and operations in space must be a national

effort. The Army's role is to participate in that effort, both in research and development and in operations.

The Army is working in support of both the National Aeronautics and Space Administration and the Adanced Research Projects Agency of the Department of Defense in the furtherance of the national space effort. All space research and development projects and funds for these projects are provided by these two agencies. Because of its record of success in space, and its capabilities, the Army is particularly suited to this role.

The Army, in furtherance of its primary mission, has specific requirements for not only data that can be obtained from satellite and space vehicles, but as in the case of communication satellites, for their actual use. The functional areas in which the Army has requirements are survey and geodesy, communications, meteorology, intelligence, and space defense, which I have shown on the chart at the rear of the room.

Since General Barclay and Dr. von Braun have covered in some detail communications and meterology, I shall not read those parts of my statement.

With respect to geodesy——

The CHAIRMAN. May we inerrupt for a moment, General. A colleague of mine has asked what geodesy is. I do not know. I think every member of the committee would like to know.

General DICK. It is the location of various points on the surface of the earth with relation to one another.

Mr. MILLER. The Navy needs geodesy much worse than the Army when it comes to getting ships from here to there.

General DICK. We both need it.

Mr. MILLER. Of course.

General DICK. Within the Defense Establishment, mapping as it pertains to land surfaces is an Army responsibility. The sea topography is a responsibility of the Navy, the preparation of charts as opposed to maps.

Mr. MILLER. I understand the Air Force takes jurisdiction over both.

General DICK. I had not so understood.

In addition to geodesy the Army also has primary responsibility for mapping. Accurate maps are needed for land warfare. Accurate geodetic data must be obtained if firing data for long range missiles is to be calculated accurately. Even through limited use of satellites thus far, the Army Map Service has corrected the location of some Pacific Islands by as much as 2 or 3 miles. There is a most urgent requirement for a survey and geodesy satellite.

I shall skip the paragraphs on communications and meteorology with your permission.

(The paragraphs skipped are as follows:)

COMMUNICATIONS

The Army maintains an extensive communications network worldwide, consisting of radio, telephone, and teletype. These communications serve not only the Army but also the Air Force, Navy, State Department, and other Government agencies in many oversea areas and are subjected to tremendous workloads even during peacetime. Additionally, the radio frequency spectrum becomes more overcrowded with every year that passes, and long-range radio communi-

cations linking oversea commands with the United States are subject to atmospheric disturbances. In view of these facts, worldwide communications must be improved. By acting as radio relay stations in space, earth satellites can help overcome, to a pronounced degree, these communications deficiencies. The Score satellite, fired last December, demonstrated the feasibility of communication by satellites. They can transmit speedily tremendous amounts of communications traffic over long distances. One technique is to transmit data by ground radio in the United States to a satellite passing over the United States for storage on a tape recorder. As the satellite passes over an oversea installation or field unit, it is interrogated and thereupon transmits the recorded data to a ground receiver. Another technique will be the use of communications satellites in 24-hour orbits; this technique will provide an instantaneous worldwide communication capability. Such capabilities will provide hitherto undreamed of speed and efficiency in communications support not only for Army operations but also for commercial application as well. The Army Signal Corps is actively participating for ARPA in the development of communication satellites as well as in the development of the necessary ancillary ground stations.

METEOROLOGY

Weather has historically exerted an important and often predominant influence on land warfare. By obtaining information on cloud cover and other atmospheric phenomena, the earth satellite will provide basic meteorological data which will produce more dependable weather forecasts to the field Army worldwide. Although all military services and other Federal agencies are interested in weather, each has requirements peculiar to its mission. Specific Army interests lie in receiving basic meteorological data for long-range planning and also in receiving local weather data pertaining to specific areas of land combat. Being developed today for ARPA by the Army Signal Corps is a meteorological satellite package that ARPA plans to place in orbit before the end of this year.

The CHAIRMAN. All right.

General DICK. Although each of the military services has a reconnaissance and intelligence requirement, each has targets peculiar to its mission. In conducting ground warfare, the Army must determine the existence and exact location of ground targets. These include "deep" targets such as missile launching sites, troop concentration areas, communications centers, or defense complexes interfering with operations of our ground forces. The ground soldier must have the capability to maintain continuous surveillance over highly mobile enemy forces to prevent being surprised. He must also have the means to assess damage. The earth satellite promises improved capabilities to satisfy the Army's requirements.

Space defense: The assignment to the Army of the task of developing an antiballistic missile weapon is a logical extension of the Army's responsibilities and capabilities in air defense. This leads directly to the problem of intercepting and destroying all enemy missiles or space vehicles threatening our Nation or our forces in the field. A weapons system capable of solving this problem is an early development objective.

My previous statements have been restricted, in the main, to the exploitation of space by earth satellites which are under development at the present time. Only current Army missions have been analyzed as they are affected by the space age; however, the Army recognizes that man stands on the threshold of the space age, and that new scientific discoveries and accomplishments may well bring changes not only in capabilities to accomplish old missions but in the missions themselves. It is possible in the future that the Army can employ rockets and missiles to deliver troops and critical supplies where they

may be required. New missions and new capabilities will evolve with time. The Army is determined to keep pace with this evolution as it occurs.

To summarize Army interests and requirements in space, I would like to restate that the Army believes that space exploration must be a national effort, and that the functional areas in which the Army has immediate requirements are survey and geodesy, communication, meteorology, intelligence, and space defense. In addition, we foresee in the future the possibility of transporting Army troops and supplies by ballistic missile.

My second subject is concerned with the status of anti-ICBM development.

During World War II, the employment of the V–2 ballistic missile ushered in a new era in warfare. Immediately after cessation of hostilities, the Army laid plans to develop a family of guided missiles, both offensive and defensive.

Perhaps our most difficult requirement was for an antimissile missile.

Several years ago, a feasibility study conducted for the Army by the Western Electric Co. and Bell Telephone laboratories, indicated that it was possible, using extensions of then known techniques, to design and construct an air defense guided missile system which would be capable of engaging all forms of the air threat expected to exist in the 1960–70 decade including the ICBM.

As a result of this study, which included some development work in order to verify the practicability of applying certain new theories and concepts, a system development program was ordered by the Army. This system is the Nike-Zeus, and in its design, primary attention was to be given the ICBM threat.

System development of the Nike-Zeus proceeded at a fairly normal rate but with great success for several years. As it became apparent that the ICBM threat was quite a bit ahead of earlier predictions, on January 16, 1958 the DOD instructed the Army to proceed with the development of the Zeus system as a matter of urgency. Several months later, a 1959 budget amendment provided sufficient support for a highly accelerated development program, and still later, the Advanced Research Projects Agency and the Atomic Energy Commission supported several research projects designed to help clear up certain unknown physical phenomena associated with the AICBM problem.

Development progress to date has been most encouraging and the program is on schedule. During the course of the program several major technical breakthroughs have been achieved. For example, the successful implementation of a new technique in the radar field has made it possible for the first time to obtain very large volume coverages on large numbers of very small targets at very high data rates. Furthermore, the application of this new technique does not require the invention of new and vastly sophisticated receiver or transmitter elements. Rather it makes use of the best components which can be made available at any given time but in a system concept which not only permits existing components to be used to greatest advantage, but also provides the flexibility of permitting higher performance components to be substituted at any future time without

major redesign or modification. In addition, very substantial progress has been made in the field of solid propellants. The Nike-Zeus will be a three-stage missile, all stages being powered by solid propellant rocket engines. The first or booster stage is, of course, the largest. A milestone was reached when on August 26, 1958 a full-scale Zeus test engine was successfully static tested at a measured thrust of 450,000 pounds. This thrust lasts for only a short time, about 41/2 seconds, but this is sufficient to launch the missile at a speed high enough to insure intercept of the incoming enemy nose cone.

The development program for the Nike-Zeus AICBM has now progressed to the point where several test models are being fabricated. These models will be used to demonstrate the system against various types of targets including actual ballistic missiles. The Army does not mean to imply that no problems have arisen during this program. Rather we wish to convey the great confidence we have in the success of the system which has been brought about by the manner in which all problems met to date have been successfully and rapidly solved.

The threat to this Nation is a dynamic one which grows greater both quantitatively and qualitatively with time.

In summary, gentlemen, the Army is proceeding with an urgent development program designed to demonstrate the feasibility of the Nike-Zeus AICBM system. Our progress to date plus the success of the Army-industry team effort with the other two Nike systems, Ajax and Hercules, provide confidence that the Nike-Zeus system will be successful. The Army believes that the Zeus system, when deployed, will counter not only the ballistic missile threat of the near future but can also grow to meet the more sophisticated missile which is sure to come.

I have appreciated this opportunity of appearing before the committee and shall be happy to answer any questions you have during the discussion period following the next Army speaker. The next speaker will be Maj. Gen. Dwight E. Beach, Director of Air Defense and Special Weapons, Office of the Deputy Chief of Staff for Military Operations, Department of the Army.

The CHAIRMAN. General Beach, suppose you proceed and then we will ask both of you gentlemen questions on what you have covered. General Beach, you may proceed.

STATEMENT OF MAJ. GEN. DWIGHT E. BEACH, DIRECTOR OF AIR DEFENSE AND SPECIAL WEAPONS, OFFICE OF THE DEPUTY CHIEF OF STAFF FOR MILITARY OPERATIONS, DEPARTMENT OF THE ARMY

General BEACH. Mr. Chairman and members of the committee; the purpose of my presentation is to inform you of the Army's roles and missions in air defense and its role in surface-to-surface missiles of ranges beyond 200 miles. The roles and missions are comprehensive and include such items as provision of forces, operation of a training and logistical base, and the development of weapon systems.

These roles and missions are derived from the primary functions assigned to the Army. Among these primary functions two have

a direct bearing upon this discussion. The first function assigned to the Army and which I now quote is:

To organize, train, and equip Army forces for the conduct of prompt and sustained combat operations on land—specifically, forces to defeat enemy land forces and to seize, occupy, and defend land areas.

In order to carry out its assigned function and to survive on the modern battlefield, the field Army must be provided with effective air defense means. Freedom of movement on the battlefield depends to a significant degree upon the quality of the air defense provided. The field Army commander requires organic air defense forces which are designed specifically to meet the broad vista of tactical situations which can occur in land warfare.

The Army must have weapons which possess the necessary mobility characteristics to provide air defense for the most forward ground elements. Behind the forward elements we must have effective air defense for the larger echelons; that is, the divisions and corps. Further to the rear our lines of communication must be made secure against air attack if we are to sustain ground combat operations.

Accordingly, the Army uses the weapons family concept for air defense of combat forces. We have in the research and development phase an optimum family of air defense weapons for field Army use. Because of the classified nature of these developments, I cannot discuss them at this time; however, I can state that they are intended to replace the Nike Ajax missile system and the small automatic antiaircraft guns which are a part of the field Army today. Included in this family of weapons we require a system to defend our forces against attack by ballistic missiles.

In addition, the possible rapid deployment of strategic Army forces and other airborne units places the requirement of air transportability on certain of the Army's air defense weapons.

It might be advantageous if a single weapons system could be developed to meet all air defense requirements for the forces in the field; however, the state of the technical art, coupled with the variations in mobility and other requirements, precludes such a single weapon concept for at least many years and possibly forever.

The second primary function of the Army is—

To organize, train, and equip Army air defense units, including the provision of Army forces as required for the defense of the United States against air attack, in accordance with doctrines established by the Joint Chiefs of Staff.

The Army in fulfilling this responsibility provides air defense weapons in support of specific requirements determined by the Commander in Chief, North American Air Defense Command, General Partridge, and approved by the Joint Chiefs of Staff. Certain of the Army air defense weapons which are developed for field Army use are equally effective against the air threat to the United States. Examples of this dual capability are found in Nike-Ajax, Nike-Hercules, and Hawk. Ajax and Hercules are now deployed in both the United States and overseas. Thus the optimum family of surface-to-air missiles for U.S. defense includes some of the new weapons being developed for the field Army.

Considering the cost and time required to develop a modern and complex air defense missile system, the advantages of employing essentially the same system both in the United States, at overseas

bases, and in the field Army should be obvious. A recent example of this was the deployment of a Nike-Hercules battalion to Taiwan on an emergency basis.

With the threat of the ICBM ever increasing, the Army considers that active defense against ballistic missile attack is a most pressing requirement. For the past 2 years the Nike-Zeus antimissile missile system has been under active development.

I will now discuss the Army's basic concept for providing air defense. It is apparent that a vast outlay of funds would be required to provide a completely adequate level of air defense for every square mile of the United States. In addition, it is beyond the state of the art to produce an air defense system which will guarantee defeat of the threat beyond the limits of the United States.

Accordingly, a realistic air defense capability can be maximized only by tailoring defenses specifically for protection of vital priority installations. Examples of these are Strategic Air Command bases, population centers, and military forces overseas.

As these adjacent local defenses become integrated they provide defense coverage of large areas in addition to the denial of penetration to priority installations. Therefore, as a determined enemy attempts to press home his attack he must face increasing concentration of fire power.

The Department of Defense concept for air defense is defense in depth. The Army wholeheartedly supports the DOD concept. We believe the first priority is for the deployment of local defense weapons around vital installations and subsequently pushing these defenses outward to the extent resources are available to permit engagement of any attacker as early as practicable. This is basic military philosophy as opposed to the Maginot Line concept. A simple analogy to our defense in depth is the infantry platoon in the defense. Patrols and observation extend out to the front. As the enemy moves in, warning is given by these patrols and the enemy is engaged by the long-range weapons; that is, the artillery. Finally, as he makes his final assault, all of the infantry weapons, to include mortars, bazookas, machineguns, rifles, and even pistols come into being. History has proven that defense in depth is required. A perimeter air defense may appear at first glance to be attractive. Once the hollow shell of a perimeter defense is penetrated by a determined enemy, the naked area within is helplessly exposed.

To implement this defense in depth concept, the Army has investigated many different approaches to the problem. In each instance we have considered the current and future threat as well as the vulnerability of air defense systems to enemy attack. Both highly centralized and decentralized systems have been studied. As a result we believe in decentralization as far as practical. Although the Army research effort is aimed at meeting requirements in the future, we do not develop and engineer a new weapon system whose concept exceeds the state of the art by so much that the new system cannot become operational in time to cope with the threat. This is particularly true in defense against ballistic missiles. In other words you have to learn to crawl before you can walk and learn to walk before you can run.

A comparison of existing Army systems with other existing systems would be welcomed by the Army. However, the comparison

of existing systems with others not yet operational is of questionable validity. The acceptance of a concept as a weapon system over an existing or feasible engineered system could be disastrous.

The Army's air defense weapons are based upon what may be called the "building block" concept. Each battery is a completely self-contained combat unit and as such is capable of fully autonomous operation. The basic building block is the battery. The level of defense of an area can be increased on a pay-as-you-go basis by the addition of more batteries. Because each battery is an autonomous unit it is not dependent upon inputs from widespread radar networks or other ground environments which contain centralized control centers and thus are vulnerable to enemy action. Of course, Army air defense batteries are designed to accept such supplemental target location and identification data which may be available from external sources.

To support its air defense function the Army has an established support base of considerable magnitude. This support base includes development, testing, training, and supply facilities. The Army contractor team which developed Nike Ajax is unequaled in know-how and experience. This same team developed the Nike-Hercules and is now developing Nike-Zeus.

Army air defense systems of the Nike family are the only surface-to-air missiles deployed today in our defense. As such they constitute the hard core of U.S. active air defense means. The Army is proud of this significant accomplishment.

Turning now to the Army's missile role in the range of 200 miles and beyond, I shall mention again the first function of the Army which I quoted, referring to "sustained combat operations on land—specifically forces to defeat enemy land forces and to seize, occupy, and defend land areas."

The accomplishment of this assigned function requires that the field commander have at his disposal adequate weapons in terms of range and hitting power to assure his forces survival and the defeat of the enemy. He must be able to attack and destroy any enemy target which seriously threatens his mission. The expansion of the battlefield under the threat of atomic warfare has greatly increased the distances to which the Army must reach in order to engage and destroy the enemy threat against it. This threat now includes enemy guided missile launching sites and missile and atomic warhead storage facilities in addition to the type of targets encountered in past conflicts.

At the present time the longest range Army missile to meet the foregoing requirement is the Redstone.

This system provides a potent weapon at Field Army level, fully responsive to the needs of the Army commander.

Redstone is the result of a program begun in July 1950. The original program was for a missile of over 400 miles' range. However, at a later date it was determined that the weight of the warhead to be carried required a reduction in range to about 175 nautical miles, or about 200 statute miles.

The Redstone development program proceeded on the basis of a 200-mile range, and in December 1955 the decision was made to weaponize the system. The present Redstone, developed by the Army

ballistic missile team at Redstone Arsenal, is the result of this program.

Redstone was the first large U.S. ballistic missile. As such, it has contributed to other advances in the fields of missiles and space activities such as improvements in inertial guidance systems for large rockets, high altitude research, and in experience valuable to the Jupiter program.

The 200-mile range of the Redstone permits engagement of a large number of targets across an entire Army zone. Redstone has full cross-country mobility and has demonstrated in firing its suitability for troop use. Its employment in launching the Explorer satellites has further confirmed the Redstone reliability and the accuracy of the guidance system. Redstone, fully field tested, has been deployed overseas to provide fire support of United States and allied ground forces at Field Army level.

Emphasis is now being placed on the replacement missile for Redstone. This is the Pershing, utilizing the latest techniques in guidance and engineering design. Pershing was authorized for development in January 1958.

Pershing will be smaller and lighter in weight than Redstone and, using a solid propellant motor, will be particularly appropriate for field use under the Army concept of mobile operation. It will provide quick response, increased rates of fire, and will be fully air transportable. We envision that this missile will be employed by small compact organizations which can operate with minimum probability of detection by the enemy over any type of terrain. All the experience gained from other missile programs is being applied in the design of the Pershing missile and its associated ground equipment. The result will be a weapon as reliable as the artillery on which so much depended in World War II and Korea, but with the increased range, flexibility, and striking power which we must have for survival in the future.

The Army has still another role—that of supporting the Nation's deterrent forces. The Jupiter missile, developed concurrently with the Redstone, and by the same team of ballistic missile scientists, is in production for operational use today. Accuracy and reliability of the Jupiter has been conclusively demonstrated in numerous firings, and the difficult problem of reentry was solved as early as August 1957. The reentry into the atmosphere and recovery of a full-scale Jupiter nose cone in May of 1958 furnished additional proof of success. The method of solution of this one problem alone reduced the test firing otherwise required by a substantial degree, with corresponding savings in money and missiles. Operational responsibility for the Jupiter has been assigned to the Department of the Air Force, who will man and deploy this weapon. The Army is producing missiles and equipment for the system, and has furnished training and technical assistance to the Air Force to enable an early operational capability.

In summary, the Army looks forward to the future with confidence, based on past history as indicated by these Army firsts of which the Army is very proud.

First U.S. ballistic missile firing, in May 1947. That was a Corporal that went some 62 miles.

The Army made the first penetration of outer space, in February 1949.

First successful intercept of aircraft by guided missile, November 1951.

First operational air defense GM unit, December 1953. That was the first in the free world, the Nike-Ajax.

The first U.S. operational ballistic missile unit, November 1954.

First free world successful IRBM firing, May 1957.

First free world solution of reentry problem, August 1957.

First free world satellite in orbit, Explorer I, January 1958.

First intercept of very low altitude aircraft, May 1958.

First intercept of very high altitude supersonic target missile, December 1958.

From these, I feel that our confidence is warranted.

I have appreciated the opportunity of appearing before the committee and I shall be happy to answer any questions you may have. Thank you, sir.

The CHAIRMAN. I want to say this: Both of these statements, the one made by you, General Beach, and the one made by Maj. Gen. W. W. Dick, Jr., are excellent statements on the use of missiles.

General BEACH. Thank you, sir.

The CHAIRMAN. I read with great interest the discussion of your defense in depth. That is the concept of warfare adopted in the Army. Now, that is the concept of our defense used in Korea, too, was it not, with such success?

General BEACH. That is right.

The CHAIRMAN. That is what really beat the Chinese in Korea; and we are simply transferring the theory of defense in depth to our own country.

General BEACH. That is correct.

The CHAIRMAN. Now, in the development of this defense in depth, the Army has three types of missiles in the Nike series, really four. Would you call the Pershing part of the Nike series?

General BEACH. No, sir; Pershing is a surface-to-surface missile to be used with the Field Army.

The CHAIRMAN. You have Nike-Ajax, Nike-Hercules, and Nike-Zeus.

General BEACH. And Hawk, also.

The CHAIRMAN. So there would be four types of Nike missiles and then you have the Pershing. Now, is the Nike-Ajax going obsolete?

General BEACH. It is still effective, but we are replacing it as rapidly as we can with the Hercules. Hercules, as you know, is now on site, and it is replacing the Nike-Ajax because it is far more effective.

The CHAIRMAN. The Hercules is being used in the general defense of the United States by the Army.

General BEACH. That is right.

The CHAIRMAN. Then, as to the Zeus, you state that its development is proceeding rapidly.

General BEACH. Right, sir.

The CHAIRMAN. Have we reached a point, however, where we could say that it is approaching operational qualities? If you do not want to answer that in open session, do not hesitate to say so.

General BEACH. I am a little afraid to answer that one in open session, Mr. Chairman.

The CHAIRMAN. We are depending, however, on the Zeus for intercepting ballistic missiles.

General BEACH. That is right.

The CHAIRMAN. Do we have any other missile, any other weapon in either the Army, Navy, or Air Force for that purpose?

General BEACH. No, sir; there are no other weapons in development to intercept an incoming ICBM. There are some other studies on this whole problem, but the only development program leading to some hardware is the Nike-Zeus.

The CHAIRMAN. Can you tell us in open session anything about the studies that have been made?

General BEACH. All of the studies that I have read are stamped secret, sir.

The CHAIRMAN. Well, we are placing, then, our full reliance for intercepting missiles on the Nike-Zeus, and you state that we are pretty well financed on that program.

General BEACH. As far as research and development is concerned it is proceeding as rapidly as it can.

The CHAIRMAN. Is there anything that we can do, since we have placed such heavy reliance on the Zeus, to help speed the development of that program?

General BEACH. Yes, sir; there is one thing. You could start establishing a production base for it now. It is a question of taking a slight risk, perhaps, but there is a certain amount of leadtime from the time you decide to go into production until you have an operational unit. The longer you delay starting your production line, the further off that operational date becomes.

The CHAIRMAN. Well, that would mean, then, the beginning of the plans for the release of contracts for the construction of Nike-Zeus?

General BEACH. Of the actual sites, no, sir.

The CHAIRMAN. The building of the missile, itself?

General BEACH. Construction of facilities in which you would build the various components of the missile, yes.

The CHAIRMAN. Well, can't you use the Zeus in Ajax and in Hercules sites?

General BEACH. I doubt very much whether the Ajax and Hercules sites will be suitable for the Zeus. In addition, you must have air defense against the air-breathing threat so Zeus will not make the missiles that will combat the aerodynamic threat obsolete. The facilities I had reference to were production facilities that would make up parts of the Zeus systems. It would be a little early now to actually start constructing Zeus sites.

The CHAIRMAN. You would begin to work on the factories from which you could produce parts for the Zeus in quantity?

General BEACH. That is right, sir.

The CHAIRMAN. That ought to start at once. You haven't started it yet?

General BEACH. Well, the decision was made, as Secretary McElroy has testified that, based on the advice of top scientists, we weren't far enough along in the research and development area to warrant going into production, and that is the status now. The de-

cision was made above my level, and probably for very good reasons.

The CHAIRMAN. So this committee could recommend that we push the program of planning production for the Zeus. Is that correct?

General BEACH. The committee could recommend anything it chose, I am sure.

The CHAIRMAN. But I am asking you for suggestion there, and you suggest that is the way we could help?

General BEACH. From my level we recommend going ahead with production. We thought that the threat was so urgent that it was warranted. The decision was made not to do so, and I am loyally abiding by the decision.

The CHAIRMAN. Well, now, from your viewpoint, from your level, is that program being delayed?

General BEACH. Well, as I said, there is a certain fixed leadtime from the time you start production until you have the first operational unit. That is fixed. The longer you wait to start your production, the further off that operational date becomes.

The CHAIRMAN. So we have been dragging a little bit, and it is time then to start, is that your statement?

General BEACH. That was our recommendation, but that is not the position of the advisers of the Secretary of Defense.

The CHAIRMAN. I want your recommendation, General.

General BEACH. Well, my recommendation is the same as it always has been, to start early production facilities so we could get a capability——

The CHAIRMAN. We will have the Secretary of Defense here later on. We will ask him about that also. He has consented to come, and we will hear from him.

Now, the Pershing is your newer successor to the Redstone, and that is not a part of the Nike series?

General BEACH. That is correct, sir.

The CHAIRMAN. Before I get away from the Zeus, would you say that the Zeus is effective, and to what extent could you tell us its effectiveness?

General BEACH. Well, we have very high confidence that it is going to be very effective. It has a history behind it as an outgrowth of the Nike-Ajax, which was the world's first surface-to-air missile. Those same basic techniques were used to make the Nike-Hercules, which is many times as effective as Ajax, and those same basic techniques and the same team is developing the Nike-Zeus, so we have high confidence that it will be a very effective system.

The CHAIRMAN. You believe it will be better than 90 percent effective?

General BEACH. Yes, sir; I do.

The CHAIRMAN. Now, the Pershing successor to the Redstone will have what additional qualities over the Redstone?

General BEACH. First, it will be much smaller and lighter and therefore much more mobile.

The CHAIRMAN. It is portable, then, over our roads?

General BEACH. Yes, sir. It will have the mobility of medium artillery. It has a solid propellant. We get away from the problems of handling toxic liquids in the field, which is quite a difficult problem. It is much simpler. We need fewer people. It is much more reliable, and its range will be greater than that of Redstone.

The CHAIRMAN. So you could deploy that either in the homeland or overseas, as you wished, and it would have the mobility of shifting from one position to another?

General BEACH. Yes, sir. Redstone has the same capability, but not to the degree that the Pershing would. You could deploy Redstone anywhere. It can be moved.

The CHAIRMAN. But it is rather difficult. It is rather a large missile.

General BEACH. It is a large missile, and it uses liquid propellants, and that is rather difficult to handle out in the field.

The CHAIRMAN. What is your program for constructing Pershing and making it operational?

General BEACH. Well, the research and development is going on at an optimum rate. I believe the operational date is classified, Mr. Chairman, but as soon as we have Pershing, it will replace our Redstone.

The CHAIRMAN. The operational date is classified, but is there any problem? Do you have enough money?

General BEACH. Yes, sir; we have sufficient funds for the Pershing.

The CHAIRMAN. So there is nothing that we can do to push that program in the committee; is there?

General BEACH. Not to my knowledge; no, sir.

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. We have heard witnesses of another service use the term "aerospace."

What service do you think should have overall responsibility for military space activities?

General BEACH. Well, I never heard of that term before. I always heard of "armospace."

Mr. MCCORMACK. Well, we encountered it the other day, a very sweet term, a very all-embracing term. As I said to somebody in the Army, whoever coined it ought to be made a full general.

But my question is, what service do you think should have overall responsibility for military space activities?

General BEACH. Congressman McCormack, I don't believe any one service should have overall responsibility. It should be a national effort.

As General Dick has outlined, the Army has specific requirements in space, and our position is that no single military department should be assigned sole responsibility for military space operations. Maybe General Dick could elaborate.

Mr. MCCORMACK. What about duplication, lack of coordination?

General BEACH. I believe we have sufficient coordinating agencies to prevent any duplication or overlapping.

Mr. MCCORMACK. Where are they?

General BEACH. At Department of Defense level, sir, and outside of Department of Defense, so that there will not be duplication between the military and the civilian.

Mr. MCCORMACK. How much money do you need to start production on the Nike-Zeus system?

General BEACH. Could I defer that to General Dick, sir?

Mr. MCCORMACK. My questions are asked of anyone that you may want to collaborate with.

General DICK. If a decision were made that production would proceed as soon as possible, we would require about $30 million in this fiscal year. We would require an additional $700 million in fiscal 1960.

Mr. MCCORMACK. This fiscal year is 1959. Is that what you mean, General, the remainder of the fiscal year?

General DICK. We need $30 million if we decided to get going right away in this year. We would need an additional $700 million in fiscal 1960.

Mr. MCCORMACK. Starting July 1 of this year?

General DICK. That is right.

Mr. MCCORMACK. What is the earliest operational date for this system?

General DICK. I think that would be better covered, Mr. McCormack, in executive session.

Mr. MCCORMACK. And also how soon it could be put into production, would you rather state that in executive session?

General DICK. I would prefer to; yes, sir.

I might state, sir, that we have about a 15-minute presentation which we would like to give you in executive session, which I think will clear up many of the questions which probably exist in the minds of the committee members.

The CHAIRMAN. If the gentleman would yield for a question.

You agree with the witness who has just testified that it should be put in production at an early date?

General DICK. That is my personal opinion, yes.

Mr. MCCORMACK. Why does the Army favor the point-defense weapon such as Nike instead of the longer range weapon such as Bomarc?

General BEACH. The Army, per se, does not necessarily favor the point-defense weapons over the others. I think in my opening statement I explained the building-block principle, that we first defend our critical installations, such as SAC bases or population centers and our retaliatory force; that a long-range system is fine if it works. Now, we have in being efficient and capable systems such as the Nike-Ajax and the Nike-Hercules that are now on sites, something over 200 sites, and the only ones that are operational today. We think by an extension of these you could get a relatively high order of defense. The problems involved in an unmanned, long-range system would be fine if they were all solved. We support the Department of Defense completely in their defense in depth, which is a mix of weapons. We have both point defense and area defense. The interceptors and the Bomarc are area-defense weapons. That is a responsibility of the Air Force. The local defense is a responsibility of the Army. We feel you have to have a mix of both systems. The interceptor will probably be with us for some time to come.

General DICK. I think that is a fair statement.

In my opinion point defense is not a choice descriptive term. It gives a concept of a defense which is not a true reflection of the weapon. Many hundreds or thousands of square miles can be covered in, for instance, a Hercules battalion's effective area, so it is in itself a pretty good weapon for covering an area.

General BEACH. Could I expand on this, also?

The area defenses require an elaborate communications system. Our local defenses are autonomous. We use centralized control, but if that should ever break down, our weapons can still fire. If you are completely dependent on a centralized system and that centralization and communication should go out, your system is probably not very effective. Also, we feel a system of defense based on a multiplicity of point defenses is basically cheaper than an area-defense system, which requires very expensive missiles, very complete radar coverage and centralized and extensive communications.

Mr. McCormack. How much is the Army now spending on surface-to-surface missiles in the present fiscal budget or in the 1959 budget?

General Beach. In the 1959 budget we are spending about $450 million.

Mr. McCormack. How will that compare with fiscal 1960?

General Beach. It was $50 million more in 1959 than in 1960. In other words, we are spending in round figures $400 million in fiscal year 1960, and in round figures $450 million in fiscal year 1959.

Mr. McCormack. Do you think that is advisable? What is your opinion on that? I will put it that way.

General Beach. Well, this budget was worked over very thoroughly. This was the decision, and I am willing to support it. We are getting our Pershing at——

Mr. McCormack. In other words, what you are saying is that you have to support it.

General Beach. Well, we are getting our Pershing going along at the optimum rate.

Mr. McCormack. I think I have got enough from your answer. I am not going to press it any more, General.

Now, we have been told, the country has been told, by no less authority than Secretary of Defense McElroy, and I quote him:

> Our principal reliance at this time is on the heavy and medium bomber capability of the Strategic Air Command. That is certainly No. 1. We have, however, major supplements to that in being.

But he says that SAC is certainly No. 1.

Do you consider the ICBM to be the decisive weapon in the foreseeable future?

General Beach. I think at some time in the future it become the decisive weapon.

Mr. McCormack. What do you mean by sometime in the future? Would you give an idea?

General Beach. Well, when both our enemies and ourselves have sufficient of them, and the manned bomber fades out of the picture. Right now I agree that our main force is in SAC. It is a very fine force.

Mr. McCormack. Well you have talked about the antimissile missile. That is what you have referred to?

General Beach. Yes, sir.

Mr. McCormack. And if an antimissile missile is capable of development, wouldn't it be much easier to develop a defense against bombers?

General Beach. Would it be easier, sir?

Mr. McCormack. Yes.

General BEACH. Well, I still think we need a defense against bombers. Maybe I didn't get your question, sir.

Mr. MCCORMACK. I said if an antimissile missile is capable of being devised and put into operation from a practical angle, wouldn't it be also as easy if not easier, to develop a defense against attack by bombers?

General BEACH. Yes, sir; that is what our surface-to-air systems, such as the Hawk and the Nike systems, are designed to do.

Mr. MCCORMACK. What do we have to counter missiles other than missiles of our own? Suppose the Soviets perfect an intercontinental ballistic missile before we do?

General BEACH. Well, our counter is our SAC, our manned bomber, today.

Mr. MCCORMACK. Well, all right, suppose they perfect their intercontinental ballistic missile before we do and perfect a pretty good defense against SAC; where are we?

General BEACH. Well, if they do both of those things, we are in a bad way.

Mr. MCCORMACK. That is not an improbability, is it?

General BEACH. Well, for the immediate future, I would suspect that they could not have an airtight defense against SAC.

Mr. MCCORMACK. What do you mean by immediate future?

General BEACH. The next year or two or three.

Mr. MCCORMACK. Well, of course, we are dealing with a pretty sinister mind on the other side.

General BEACH. Yes, sir, but we also have an ICBM program which is coming along, and we also have some IRBM's.

Mr. MCCORMACK. Well, in other words, we could have control of the sea and command of the air areas within our defense positions and of the land areas and still lose if we lacked missile strength, couldn't we?

General BEACH. It would be possible, yes. That was one of the reasons we have been pushing for the Nike-Zeus. We think that an undefended retaliatory force such as SAC should be defended. It is pretty dangerous to leave it open.

Mr. MCCORMACK. Our B–47's are now our main potential striking force in the delivery of nuclear bombs, is that correct?

General BEACH. I believe the B–52 is also in there. I am not an expert.

Mr. MCCORMACK. Yes, that is true, but I say our B–47's because of the numbers we have.

General BEACH. That is probably correct.

Mr. FULTON. The Snark would be in there, too.

General BEACH. Of course we also have forces deployed overseas with weapons that can reach.

Mr. MCCORMACK. Well, of course, they are vulnerable.

General BEACH. Well, we also have some on board ship.

Mr. MCCORMACK. That is true.

General BEACH. Our whole spectrum of weapons is still pretty formidable, I'd say.

Mr. MCCORMACK. I am not disputing that. But our bases overseas, in case of a general attack, would be vulnerable.

General BEACH. Yes, sir.

Mr. McCormack. The extent to which carriers could be used in modern warfare is a matter of serious dispute among military minds, as I understand. Is that correct, their vulnerability?

General Beach. Well, I believe there is some discussion along that line as compared with the Polaris submarine.

Mr. McCormack. Well, when you get into the Polaris, you get into a little different situation from a large aircraft carrier.

General Beach. Yes, sir.

Mr. McCormack. Now, our B–58 program is not going ahead very well; is it? They have been cut down; haven't they?

General Beach. I believe so. I am not competent to talk about the B–58's numberswise.

Mr. McCormack. Well, they are intended to replace the B–47; isn't that correct?

General Beach. The B–52, I believe.

Mr. McCormack. There are more B–52's provided for in the budget, and the Hound Dog, the air-to-surface missile, but the B–58's have been pretty well cut down.

General Beach. I don't have the facts at my fingertips on the B–58's. I would hate to comment on that.

Mr. McCormack. In other words, if the Soviets should perfect—get the bugs out—I will use that for descriptive purposes. You know what I mean. Let me ask you this: They certainly had the decided advantage on the United States, our country, on overcoming the thrust of propulsion.

General Beach. There is no question about that.

Mr. McCormack. And if we proceed upon the theory that they are not working zealously, then we are making a mistake in effecting delivery.

General Beach. That is right. We should go upon the basis that they are going ahead full speed.

Mr. McCormack. And one thing we have always got to have is a retaliatory power.

General Beach. That is correct.

Mr. McCormack. If we lose that retaliatory power, we would be in a very bad position.

General Beach. That was my point in this discussion of air defense. Retaliatory power is a combination of offensive delivery vehicles and an active and passive ability to defend that capability.

Mr. McCormack. I understand that. My questions are not to be misconstrued. I am trying to find out just this: With this powerful military strength that we have, what is our one weakness, because all I read is that overall our military strength is great, and that word "overall" is what interests me. That could change very well, that overall military strength, could it not, General?

General Beach. In this age of technological breakthroughs, I agree with you; yes, sir, it could.

Mr. McCormack. Can you say in good conscience, with 180 million Americans involved in the country, that it is not probable that the Soviets, unless we accelerate our programs, may not be in a position where they have an advantage over us in delivery of an intercontinental ballistic missile and at the same time have a pretty good defense against our intercontinental bombers?

General BEACH. Well, I think it is possible that in the ICBM area they could have the advantage numberswise, for the next few years at the current rates.

Mr. MCCORMACK. Both is what I have in mind.

General BEACH. I am not so sure as to where they stand. I don't think we have much information on their defense against ICBM's.

Mr. MCCORMACK. Well, how about defense against the bomber? If our main retaliatory power is intercontinental bomber capability of delivery and a defense against that is easier to develop than one against the intercontinental ballistic missile itself, which would seem to be reasonable, that you could prepare a defense against a 600- or 700- mile-an-hour instrument more easily than against a 6,000- or 7,000-mile-an-hour instrument, and they perfect their intercontinental ballistic missile before we do, that would be a dangerous position for our country to be in?

General BEACH. Very dangerous, yes, sir.

Mr. MCCORMACK. I am sure you gentlemen have thought of that. That is not original in my mind. It would be a sad day for America if that day ever arrives.

General BEACH. That is right.

Mr. MCCORMACK. That is all.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I am glad to have you both here and I want to congratulate the Army on its list of firsts. I think the public should know more about these firsts, and if you will fill in for me those various programs as to where they took place, under whose command, who were the scientific teams participating, and what the methods used were, I will put them in the record now.

General BEACH. Yes, sir, we will get that for you.

Mr. FULTON. There will probably be some questions on the outline, and that would serve to inform the Congress and the people generally as to what you have done. It has been a magnificent achievement.

The question first comes up on the current budget, the 1959 budget, on the development of your Nike-Zeus system. You have said that you have adequate research funds or funds for the current budget, is that not correct?

General DICK. That is correct.

Mr. FULTON. And second, that you have put into production several test vehicles of the Nike-Zeus system that you are going to test.

General DICK. More correctly stated, we have tested various components of the system.

Mr. FULTON. But you have mentioned several vehicles that you are going to move into the Nike-Zeus system.

General DICK. Well, we expect shortly to test the initial vehicles, that is correct.

Mr. FULTON. As far as the components, you tested the engine of the first of the three stages of the Zeus, but you are moving ahead now to test the vehicles.

General DICK. That is correct.

Mr. FULTON. Now, is there any major modification or change in design or redesign necessary at the present time in the Nike-Zeus system before you declare it ready for production models for testing and then operational use?

General DICK. If I understand the question——

Mr. FULTON. Do you, among yourselves, have any disputes?

General DICK. No material disputes that I am familiar with, Mr. Fulton. In any modern system it is not usual, or it is not done at all as far as I know, that you complete your system and test it 100 percent before you decide to go into production. If you did this, your leadtime would just double.

Mr. FULTON. I agree with your thoroughly. I have had some experience in that end of it.

The question is, Have you made your cutoff point where you think you are at a successful level where you can put a model into test and then into production?

General DICK. The Army so thinks; yes.

Mr. FULTON. So when the decision was made by the Department of Defense, you could not base the reason for that decision on moving toward operation, production. That was a design or a modification or a structural reason. It wasn't that, it was budget. Is that your decision?

General DICK. No, sir; I don't feel that way. It was due to a basic difference in opinion on the question of whether we were at a point where we could proceed to production within a reasonable area of risk. The Army so felt. The Department of Defense felt that we had not yet reached that point.

Mr. FULTON. I had read something about that, and that is why I asked you definitely whether you felt you were.

General DICK. We feel that we are, yes.

Mr. FULTON. Then I asked you next about the decision of the Secretary of Defense because he either made it on the basis that you were not correct on that assumption of yours as to your progress or for a budgetary reason.

Now, will you tell us who, then, in the Department of Defense feels that you are not ready to go?

General DICK. The Secretary of Defense, as I recall, has stated that based on scientific advice available to him, the decision was reached that we were not ready to go into production.

Mr. FULTON. Now, I am really inquiring who it is in the Department of Defense who disagrees with you.

General DICK. I can't say, sir; I don't know.

Mr. FULTON. Are they people within the Army or people within the Department of Defense?

General DICK. I am morally certain they are not people within the Army.

The CHAIRMAN. Are they in the Budget Bureau?

Mr. FULTON. I asked that and he said no.

General DICK. I cannot say, sir. I do not know.

Mr. FULTON. We must separate the question. First, there is a budgetary question. Second, there is the point of whether you are able to perform as you say you are. Thirdly, if the decision has been made, who is making the recommendation to the person who decided directly contrary to you on the state of progress or state of the art that you say you are in.

I believe that we should have provided for the record, with the chairman's permission, that necessary information, so we can see how the decision was made.

The CHAIRMAN. Do you think you can get that information, General?

General DICK. I doubt, Mr. Brooks, that it is available within the Army.

The CHAIRMAN. We could get that from the Secretary of Defense when he comes up here, couldn't we?

General DICK. I am sure you could.

The CHAIRMAN. Mr. Ducander, have we set up a date for him?

Mr. DUCANDER. Yes, sir; March 2.

The CHAIRMAN. If we will withhold the question, then we can ask the Secretary of Defense. I am sure he can answer.

Mr. FULTON. We will finish that later. But you certainly must have, on the staff decisions, been battling somebody down there in the Department of Defense to get your program through. You were not battling unknown, faceless people before you came up to the Secretary's level. Who were you battling down there? I am trying to help you.

General DICK. Perfectly frankly, Mr. Fulton, we were not battling anyone that I know of.

Mr. FULTON. Well, then, who is this group of ghosts who stopped this program on recommendation to the Department of Defense? Was it just done without your having a chance to make your case?

General DICK. The Army's case was made, and I feel with a certain degree of success, at certain levels in the Department of Defense. The exact group or groups who advised Mr. McElroy before he made his decision, I cannot say, because I do not know.

Mr. FULTON. How many levels of decision are there between you and Mr. McElroy?

General DICK. Well, there are quite a number before you get out of the Department of the Army.

Mr. FULTON. Just tell me. At one time—I believe Mr. McCormack will bear me out—when von Braun was here, he said he had to go through 23 levels of decision before he could go ahead. And he only had to get one "no" and he was out. We have to find out where the "no's" come from.

General DICK. My office coordinates directly with Mr. Holaday's office on most of these programs connected with missiles. That is our main point of contact. Mr. Holaday, in his position I presume, has direct access to Mr. McElroy.

Mr. FULTON. Would he go through Dr. York first at the present time? This is serious.

General DICK. I don't believe that it has been so defined in detail. I don't know. I have heard one story, and I have heard another story. As of now, we work through Mr. Holaday, and whether he is totally responsible to Dr. York, I do not know. I cannot say.

Mr. FULTON. You see, we are trying to set up a space program on this committee, find where the blocks are and find where the things are. That electric current just gets sort of dissipated as to the push for these programs. If you don't know the channels up to the Secretary of Defense in your program, I think we ought to have a statement

submitted for the record by the Department of Defense so that the Army will know it as well as this committee.

General DICK. I think we know the channels.

Mr. FULTON. I was taking you a little far as a cross-examining lawyer.

The CHAIRMAN. Any more questions?

Mr. FULTON. Yes; I have one or two more.

A question came up earlier on the ICBM threat, and I tried to point out that when we have a general weapons system that it is not that we just have to have the same number of ICBM's as the Russians. We need to have defense and defense in depth with other instruments as well.

For example, deployed abroad already have been the Nike-Ajax and the Nike-Hercules. Is that not correct?

General DICK. That is correct, sir.

Mr. FULTON. And likewise the Redstone?

General DICK. That is correct.

Mr. FULTON. And you were planning on the extension abroad of these various systems like the Pershing and the Zeus; were you not?

General DICK. Not the Zeus; no.

Mr. FULTON. Well, wouldn't you defend our major installations abroad?

General DICK. The system is designed as a defense of the continental United States. There are no plans that I know of to deploy it overseas.

Mr. FULTON. To finish with this last point, you have said that the Army has under process, under development, the sending of men and equipment by capsule and intercontinental ballistic missile and the range may be 4 to 10 thousand miles an hour for an ICBM. That would mean that you could get to Japan in an hour; you could get to Berlin in an hour; you could get to Buenos Aires in an hour. Is that right?

General DICK. Yes; those times are correct.

Mr. FULTON. That would mean that you could really use it as sort of a spray or a fountain so you could really start them from the United States and put men and equipment most any place in the world that you wanted to within a period of 1 or 2 hours, if we went ahead with such a development. Is that not right?

General DICK. No, sir; not as I see the picture. We are going to start on a much more modest level. The first requirement is undoubtedly in the neighborhood of 50 to 100 miles. The delivery within a combat area of the few specialist people or the few high-priority items of equipment and supply, both of which are badly needed.

What might lie 25 years from now in the area of delivery through missiles of people and things, I can't say. We are not going to leap into a program of deploying to Berlin and Moscow as a starter.

Mr. FULTON. No, not as a start, but in the future you would expect to be replacing planes and troop carriers and trucks and trains by capsulized forces that could be launched in any direction, regardless of weather or distance?

General DICK. I think that is a fair statement.

Mr. FULTON. I will finish this and I am through.

We have the DEW line, and the Navy has been supplying some of those outposts in Canada by ship. They have had quite a bit of trouble, as you know, with the ice floes and possible loss of use of the ships.

Why don't you right now have a practical program for supplying the Dewline by missile with their supplies? Could you not do that right now?

General DICK. I have never thought of that specific problem. I don't believe there is any present capability or immediate capability in the future for delivering the bulk of supplies which would be required.

I believe you are going to have to go in by ship for many, many years to come.

Mr. FULTON. That is all. Thank you.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. I yield to Mr. Miller.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. General, have the Russians anything comparable to the Nike-Zeus?

General DICK. I do not know, sir. I couldn't even make a good guess, Mr. Miller.

Mr. MILLER. How about the Nike-Zeus and Polaris in degree of development? Is the Nike-Zeus as far along as the Polaris, do you think?

General DICK. I am not intimately familiar with the Polaris, but I would say generally it is further along in the program insofar as it has been determined that it would be produced.

Mr. MILLER. Do you think, then, that Nike-Zeus is as far along at least as the Polaris? You must have some knowledge of that.

General DICK. I feel that in development, Nike-Zeus is probably at about the same point as Polaris, understanding that it is a much more complex system than Polaris.

Mr. MILLER. That is my question: Zeus is much more complex.

General DICK. Yes, sir.

Mr. MILLER. But you think that it is as far along in its overall development?

General DICK. I feel roughly that is so.

Mr. MILLER. But the Navy has gone into making provision for production of Polaris right now. Is that not so?

General DICK. That is right.

Mr. MILLER. And a great deal of money has been expended theoretically by a private contractor, but reimbursable by the Federal Government, in putting up a plant to build Polaris?

General DICK. That is right.

Mr. MILLER. That is about what you would like to have for the Nike-Zeus right now, isn't it?

General DICK. That has been the Army's recommendation.

Mr. MILLER. That is the recommendation?

General DICK. Yes.

Mr. MILLER. I think that is quite important.

The CHAIRMAN. We went into it before you arrived. I think it is very clear that the Army has recommended it and somewhere along the line someone turned it down. We haven't found out who turned it down, but we will.

Mr. MILLER. Well, I just wanted the record to show in one instance somebody has authorized going into the operational field or the production field in the Polaris missile and I am very happy to see them do that. The thing that I would like to see is having this done with Nike-Zeus also.

The CHAIRMAN. I think it is critically important, too.

Mr. Anfuso?

Mr. ANFUSO. General——

Mr. MILLER. Wait a minute.

The CHAIRMAN. I thought you were through.

Mr. MILLER. Well, I will be through to accommodate you, Mr. Chairman.

The CHAIRMAN. No, don't accommodate me at all. I thought you were through, Mr. Miller.

Any questions?

Mr. MILLER. No, no further questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Does the gentleman wish me to yield to him?

Mr. MILLER. No, I have no desire.

Mr. ANFUSO. Well, General, I wish to congratulate both of you on the progress you are making, I believe that all of us here are entirely dependent on you for further research and for the security of our country.

What is the range you are aiming for with respect to the Pershing, if you can say? Is that top secret?

General BEACH. I would like to answer that in executive session.

Mr. ANFUSO. Fine.

Is there a jurisdictional fight among bureaus in this research program?

General DICK. We have no bureaus in the Army, Mr. Anfuso. Do you mean between our technical services?

Mr. ANFUSO. Departments.

General DICK. I know of no serious jurisdictional battle. We are involved in a comprehensive program. It is inevitable that occasionally one technical service will move into an area which another technical service thinks it is more properly employed in. These things are quickly resolved. I know of no existing problem of that nature today.

Mr. ANFUSO. Well, I would like to know whether this statement has been correctly reported in the press.

General Twining is supposed to have made a statement in the privacy of his office, referring to the rivalry, and he said "Bureaucrats, they are a bigger threat than the Russians."

Did he ever make that statement in your presence?

General DICK. No, sir. I have never been in his presence.

Mr. ANFUSO. Do you know whether such a statement was ever made?

General DICK. I have no knowledge, sir.

Mr. ANFUSO. Now, does the Army in its research and development program take its orders from Mr. Roy Johnson or from Dr. York?

General DICK. It receives directives from both sources, each speaking of course for the Secretary of Defense.

Mr. ANFUSO. Is there any rivalry as far as you know between the two of them?

General DICK. I have no knowledge of that.

Mr. ANFUSO. Do you think that the Secretary of Defense can override either one of them?

General DICK. I am sure he can.

Mr. ANFUSO. They seem to be in dispute about that. Would you place in top priority the development of a protection system for SAC, which you regard as our main striking or retaliatory force, at this time?

General DICK. I would, and the Department of Defense does, Mr. Anfuso.

Mr. ANFUSO. Can you conceive of a more effective retaliatory force than SAC, assuming that SAC turned out not to be the best retaliatory force? Can you conceive of a better retaliatory force? Would you say, perhaps, full speed ahead on the intercontinental ballistic missile might be the better answer?

General DICK. As I understand SAC, it comprises both the manned bomber and the ICBM when it becomes operational. They will both be elements of the Strategic Air Command.

Mr. ANFUSO. Where would you place the top priority, on the development of a defense to SAC or the development of an intercontinental missile?

General DICK. I would move one along in pace with the other.

Mr. ANFUSO. You would try to move them both, in other words, at the same time?

General DICK. And I think it might be well to point out that both of these programs do have the highest national priority, the anti-ICBM for development and the ICBM for development and production.

Mr. ANFUSO. You wouldn't spare any expense to achieve that end, would you?

General DICK. I would spare no reasonable expense if I were running the show.

Mr. ANFUSO. I mean the question of trying to balance the budget wouldn't disturb you, if it involved our national security?

General DICK. I would be disturbed at a badly unbalanced budget; yes. I would be disturbed at a defense posture which appeared inadequate to me. I am sure there would have to be a balance in anybody's mind.

Mr. ANFUSO. To which would you give top priority, the security of our country or a balanced budget?

General DICK. I would give first priority to the defense of the country.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. General, I have only one question or one point I would like to discuss. I do not know to what extent you will want to comment on this. But to what extent do you feel that the Army's progress, not only the Nike-Zeus but other programs you are concerned with, by the confusion at top level as to who actually has responsibility and who is giving the orders, to what extent the Army's progress is being delayed?

General DICK. I feel, Mr. Sisk, there is some delay in processing certain decisions, employment decisions, funding decisions. This is my personal decision from where I sit. How much delay is a little difficult to define. You may be delayed in getting your money 3 months which may mean a 3-month delay. In some cases a delay of a month might bring on a year's deferment. It is hard to say. Someone else gets the money before the decision comes in.

Mr. SISK. By your knowledge, to what extent have the agreements between NASA and the Army, and Redstone Arsenal specifically, with respect to the programs you are carrying on, to what extent has the Secretary of the Army, or others who must do so, implemented or supplemented that agreement to give you clear sailing ahead or a green light?

General DICK. To the best of my knowledge, the programs of NASA and ARPA to be performed by the ballistic missile agency at Huntsville are moving at a maximum rate, at the rate which they have been funded. I know of on lack of understanding at any echelon of the agreement between the Department of Defense and NASA or how it should be applied. I hope I have answered your question.

Mr. MCCORMACK. Would the gentleman yield?

Mr. SISK. I would be very happy to answer.

Mr. MCCORMACK. You made two propositions in answer to the question, General. Proceeding at the maximum rate in accordance with the way they have been funded.

General DICK. That is right.

Mr. MCCORMACK. Well, would you separate them? Do you think they are going at a maximum rate? Suppose you had more funds; would you proceed faster?

General DICK. I think General Barclay, who is closer to this particular part of the question than I am, answered this thing last week when he stated essentially, as I recall, the provision of more funds at this time would not speed up any of our space programs. It would provide an added assurance of completion on time and completion with a successful system. I could not provide an answer which I would judge to be as good as his. He is much closer to it than I.

Mr. MCCORMACK. Mr. Miller suggested asking this question: Would you consider that as being top priority?

General DICK. The general NASA program, is that the question?

Mr. MILLER. The assurance that you would get your program, if you had more money, the assurance that the program would be completed on time. Is that not of the utmost importance?

General DICK. That is certainly of importance.

Mr. MILLER. Would you put a higher priority on anything in development than that?

General DICK. I believe we are talking now about NASA and ARPA programs.

Mr. MILLER. We are talking about enough money for you to proceed.

General DICK. Well, the particular programs that our agencies are carrying forward for NASA are not military programs. Those are space programs. My personal priority is for defense purposes first, nonmilitary space second.

Mr. SISK. Well, now General, the question, of course, that I am attempting to get at this moment is this: Let us take, for example, the Nike-Zeus. Now as I understand it, there is money to proceed along certain lines and to go so far with the program, but is it not a fact that there is desperate need for some implementation or some specific decision if that program is to be put into, let us say, operational status at sometime in the future, whether it be just for illustration 1961 or 1963 or whatever date. Is there not need right now for a decision on that matter? Is it not a fact that so far as making it useful for defensive purposes sometime in the future, that decision is being delayed, and that time is being put off month by month, awaiting a final decision, either budgetary or otherwise?

General DICK. That is the Army's decision, and that is my personal opinion, that we are losing time.

Mr. ANFUSO. Well, let me ask you this: You had a budget request for your program.

General DICK. That is right.

Mr. ANFUSO. Was that cut in any way?

General DICK. It was.

Mr. ANFUSO. How much was it cut?

General DICK. Roughly $700 million from what was the Army's objective. This would differ from what might be in the budget line item as it was finally forwarded.

Mr. ANFUSO. What was the Army's objective and why did you want this extra $700 million?

General DICK. For the purpose of going into production on the components of the system; setting up the machinery to produce.

Mr. ANFUSO. Well, now, the fact that you did not get that $700 million prevented you from going ahead with production.

General DICK. That is correct.

Mr. ANFUSO. That is all.

The CHAIRMAN. That is on the Zeus program?

General DICK. That is correct.

The CHAIRMAN. Mr. Mitchell?

Mr. MITCHELL. No questions.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. I am not sure whether this should be on the record, but let us go ahead. A few weeks ago, General Dick, some pretty rational people were discussing with me in my office the question of the still existing flying saucers. These two men hold doctors' degrees in physics. They are pretty rational people. They are right now doing some work with the Government. They did not have any facts in their hands from their personal knowledge, only the scuttlebutt that is drifting around in the Department that they work in—that there is some possibility of the existence of flying saucers, some pictures in existence and things of this kind to prove this existence.

Now maybe this sounds a bit ridiculous. I do not want it to seem so. I think a couple or three years ago we were hearing a lot about flying saucers. Today we are not. Yet these two men, who have obviously demonstrated their ability to the right department head, questioned this thing. I just thought I would ask a question on that.

General DICK. My personal opinion?

Mr. WOLF. Either one of you. It has to be an opinion, I presume.

General DICK. I speak with fear and trepidation, because my wife believes in flying saucers. Personally, I doubt the existence of any flying saucers as of now.

Mr. WOLF. Well, one of the things they mentioned was a picture that was taken, so they say, of a saucer that landed somewhere up the North Platte River, Nebr., and is in existence somewhere in the Defense Department today, this one which landed, and that there are two witnesses who apparently saw it.

General DICK. I am not familiar with that, sir.

Mr. WOLF. And there was another one down south somewhere that was seen and witnessed by purely rational people, they say.

General DICK. I chased one one afternoon in the Midwest. It turned out to be a flock of birds.

Mr. WOLF. Well, this is something that keeps coming up from time to time and since we had the Director of Research here and I thought this would be the right place to ask it.

General DICK. My research is on a little more practical lines than that. I know nothing about flying saucers of an authoritative nature.

Mr. WOLF. Would you say, then, that this is mostly whims?

General DICK. We may have been the victims of a few hoaxes.

Mr. WOLF. Thank you. I did not want to embarrass you.

The CHAIRMAN. Mr. Karth?

Mr. KARTH. No questions.

The CHAIRMAN. Dr. Hechler.

Mr. HECHLER. Mr. Chairman, General Beach, I would like to ask you one broad question to help me sharpen up the information on your program.

How do you rate the chief handicaps that you now face and face in the foreseeable future in carrying out the program that you have in mind? This is a very broad question and I would like to get a rating of what you consider in terms of importance the handicaps which you are likely to confront in the foreseeable future.

General BEACH. Are you speaking now of Nike-Zeus?

Mr. HECHLER. I am speaking of the entire program.

General BEACH. Well, I think one of our biggest handicaps, and it is going to last for a long time, is that as soon as we get an existing system in operation we immediately know how to build one far better and by the time we are developing that one and going along we know how to make one that is still much better, so we are in this constant problem of where do you stop and get something on the ground that you can fight with. Nobody has ever won a war with items on a drawing board. You have to have hardware in the hands of trained troops and this is a big problem of where do you put your money? Do you wait for another year and do nothing until you can get something far better or do you spend some now to get some hardware that will be in the hands of troops. I think that problem is the overall one. Two thousand years ago a weapons system lasted for a thousand years. Now it lasts 5 or 10 years and apparently it is going to get worse in the future, and the more sophisticated ones are also getting more expensive.

I am happy to say in certain areas they are probably getting less expensive as we know how to build them smaller and cheaper and more simply.

Mr. HECHLER. What about the question of trained scientific talent? Has that been a handicap to you in any respect or is it likely to be?

General BEACH. Well, not in my area of interest, it has not been to date. General Dick may be able to add something in the research area.

Mr. HECHLER. I would also like to ask you the same broad question I asked General Beach: Is there anything you can add in describing the handicaps likely to be encountered? I gathered from General Beach's response he felt there was no final answer to this question, that this is a matter of just measuring where you concentrate your funds.

General DICK. I agree with that entirely. I think we will always have the problem of money. There will never be enough money to go around to satisfy every requirement to the ultimate. I agree with General Beach's analysis, I think it was a good one. As far as the second part of your question is concerned, I know of no real difficulty that the Army has encountered in obtaining such scientific talent as was required. There was some delay but I think this is always the case in the technical field when trying to find the best available.

The CHAIRMAN. Mr. Hall?

Mr. HALL. No questions.

The CHAIRMAN. Mr. King.

Mr. KING. General, I have a question. There is a theoretical distinction, I suppose, between the different area of authority of the three branches of the service insofar as they relate to missile activity and space activity, but as a practical matter I see very little distinction at all. It seems to me that the three branches are trampling down the same grass and covering in large measure the same areas of activity. Would you discuss for a minute how you conceive the theoretical distinction between the assigned areas of the three branches and then discuss for a moment whether you think in practice it works out that way?

General DICK. Mr. Congressman, I feel that we have a pretty good basic division of responsibility. From the broad sense, you have warfare conducted on and in the sea; you have warfare conducted on the ground; and you have warfare conducted in the air. I think that is as reasonable a division as you can make.

My own personal feeling is, then, the next step is to provide each service and each commander with the means to carry out his responsibility. Inevitably we mesh all three areas of activity. For instance, within the Pacific, the commander in Hawaii has aerial problems, naval problems, and ground problems to consider, and he has a joint command. You get into difficulties when you get into things somewhat more specific. Some of these difficulties have been decided in the past at various levels, some by agreement, some by edict, some by law.

Basically and personally, my feeling is that we should always give the man with the job the means to accomplish the job. I do not agree with one statement you made, if I understand it correctly, that we have all services trampling down the same grass. We have an occasional duplication, I will admit. I do not think it is excessive. I do not think it is necessarily a bad thing.

Mr. KING. Well, do you have any recommendations at all in that area or do you think the problem is in hand, this problem of overlapping?

General DICK. I would have some recommendations to make if I thought it were appropriate to make them. I would have some changes to suggest. I think any man sitting in this chair from any of the military services would do things a little differently from any other. I see no great problems at the present time.

Mr. KING. Do you feel that the whole space program is sufficiently coordinated?

General DICK. I think, being as new as it is, that a great deal of coordinating effort must go on in the immediate future. I do not see anything right now from the national level that needs any radical change.

Mr. KING. Let me be a little more specific. They call it the National Aeronautics and Space Council. I believe that is the name of it and I believe the President of the United States is the Chairman of that Council. Is that correct?

General DICK. That is correct.

Mr. KING. Now, do you feel that that Council is close enough in touch with this situation and actually functions sufficiently to perform a coordinating function there, or does it tend to become more of a figurehead?

General DICK. I am not really familiar with the deliberations of the Council. I think the active operating agencies are NASA and ARPA of the DOD. Their deliberations and decisions are reported to the Council. I see no reason why the Council is not on top of the problem. NASA, and ARPA are, however, the operating and controlling agencies. I think they are active. I think they are going to have some problems. It is a big area, but I see no indication that they cannot fulfill their mission in life within the Government.

Mr. KING. Suppose there were a question as to whether NASA should assume jurisdiction of a particular project or ARPA? Would NASA have the final say-so in deciding that question or would it be this Council?

General DICK. No, I do not believe NASA would have the final say. I think such a question, if there were a difference, would have to be decided at the presidential level.

The CHAIRMAN. Would you yield?

Mr. KING. Yes.

Mr. FULTON. But it is first taken up, under the act we passed July 29, 1958, through the Civilian-Military Liaison Committee, is that not correct, to try to work out the jurisdictional matters before they go higher?

General DICK. That is correct.

The CHAIRMAN. Mr. Roush. Now before Mr. Roush asks his questions I wanted to say this, because I am afraid some of the members will get away. It was my thought that as soon as we finish these questions we would go into executive session. I have a short statement, an announcement, that I want to make to the committee in executive session. After that we could view the film. Then we will see where we are and perhaps have to adjourn until this afternoon for questions in executive session.

I was really in hopes that we would be able to finish this morning with these two witnesses, but apparently we are not going to do so. Consequently, if there is no objection to that procedure, that is the way we will proceed. Mr. Roush.

Mr. ROUSH. Mr. Chairman, I will try to make this brief. However, this Nike-Zeus question, General, leaves some question in my mind. Now, first of all, sir, do I understand that your office is charged with making recommendations as to budget requirements for an adequate air defense? Is that a fair statement?

I will put it this way——

General BEACH. Not entirely.

Mr. ROUSH. Let me ask this, General: You did make recommendations that we take steps for the construction facility for the Nike-Zeus.

General BEACH. That is correct.

Mr. ROUSH. And those requests were turned down by the Department of Defense.

General DICK. The funds were not provided in the 1960 budget as it stands now.

Mr. ROUSH. Now when this recommendation left your office, whose office did it go to from there?

General DICK. I suppose it went forward along several paths, the money path to Mr. McNeil's office. I know it went to Mr. Holaday's office.

Mr. ROUSH. All right, I am still within the Army now. You know for a fact that when the recommendations left the Army desk, so to speak, that the recommendations were still there; is that correct?

General DICK. I did not see them, Mr. Roush, I am morally certain that that was the final Army position.

Mr. ROUSH. Well, I wanted to make sure that it was not the Army or any part of the Army which caused these to be stricken from the—that is, these budget requirements which you felt you must have, stricken from the budget. As far as you know, it was still in the budget, still in the recommendations when it left the Department of the Army.

General DICK. I believe it was.

Mr. ROUSH. Now when you set that up, did you set up any series of priorities which led them to believe you did not consider this as important as other phases of the work?

General DICK. Not that I know of.

Mr. ROUSH. When you set up a budget, do you set up any priorities within the budget? I do not know, I am asking.

General DICK. I am not a budget expert, and I do not understand all of the details of budget processing. There are priorities established and there is always what is known as a shopping list which exceeds the possibility, if you will, of money.

Now the Army proceeds against its pocketbook with its shopping list, usually with priorities indicated.

Mr. ROUSH. Was there any priority indicated insofar as this proposed program was concerned?

General DICK. This program was never on any formal piece of paper that fit within the budget structure that the Army was required to operate within. It is a little bit involved. The Nike-Zeus program this year was funded outside of the Army's budget. The Army recommended that it be so funded in 1960.

Mr. ROUSH. Well, was the money in terms of dollars in your recommendations insofar as the budget was concerned? I am referring to construction of facilities for the building of the Nike-Zeus.

General DICK. I have not seen the final Army budget papers. They do not process through my desk. I have no doubt in my mind at all that the Army asked in whatever was the appropriate fashion for the rough $700 million required to go into production of the Nike-Zeus.

Mr. ROUSH. But you are not sure yourself; is that correct?

General DICK. I have not seen the papers, and the exact way in which it was stated I cannot say.

Mr. ROUSH. Just one more question. Do you know of any person in the Army, or who might be related to the Army as a civilian employee, who recommended that this item be cut from your budget request?

General DICK. I know of none such.

Mr. ROUSH. Mr. Chairman, that is all.

The CHAIRMAN. Any further questions?

Mr. SISK. Mr. Chairman, could I make one very brief statement?

The CHAIRMAN. Mr. Sisk.

Mr. SISK. This is really not a question, Mr. Chairman. I simply want to say that I appreciate the statements which these gentlemen have made, what I have heard of them. I am sorry to say I was not able to hear all of this. I want to say this: I have all the sympathy in the world for the position you gentlemen have. I realize the gun you are under on many of these questions and yet I see no other way, really, to dig out some of the problems connected with the pursuance of these programs without, let us say, to some extent putting you fellows on the spot. I did feel that should be said, but I am certainly in sympathy with what you are doing. I think you are doing a good job, in general.

Thank you, Mr. Chairman.

The CHAIRMAN. I think they have made excellent witnesses. I believe that in executive session we can get to some of these matters more quickly than we can in open session. We can certainly make more pertinent questions and perhaps get quicker answers.

At any rate, if there are no more questions now we will go into executive session and see this protrayal that the Army has. Then we will adjourn and go to the House.

(Whereupon, at 11:59 a.m., the committee went into executive session.)

EXECUTIVE SESSION

The committee met in executive session at 12 noon in room 356, Old House Office Building, Hon. Overton Brooks (chairman) presiding.

The CHAIRMAN. We are now in executive session.

At the first I want to say this: We have set up for next week—not this week—a rather heavy program, if it is all right with the committee. We hope to begin with Secretary McElroy, Secretary of Defense, and then we hope——

Mr. DUCANDER. Mr. Chairman, we couldn't get him on Monday. He is scheduled for March 2.

The CHAIRMAN. Monday, a week, then.

Mr. DUCANDER. ARPA is next week.

The CHAIRMAN. Next week will be ARPA, Roy Johnson, Dr. York, and that group we will have next week.

It is going to be a heavy schedule. We may have one or two witnesses on weather control at that time.

The announcement I want to make—and it is not for publication—is this: We will plan to leave here Wednesday, at what time, Mr. Ducander?

Mr. DUCANDER. Two o'clock, from Bolling Air Force Base.

The CHAIRMAN. We will go to Cape Canaveral, and there that same night at Cape Canaveral there will be a shot of the Thor-able missile at 11 p.m., and then at 3 a.m. the Snark will be fired. So we will have that same night two shots, and I believe everybody here would like to see those two. They are very important. We will be up a good part of the night, but we can catch up on that later on.

I wanted to make the statement. That is not for publication, because, of course, weather permitting, and other things, would govern that; therefore, I will ask you not release that.

Now, we have these pictures now. Are we ready to proceed?

General DICK. Colonel Sydnor has about 15 minutes of slides and film.

The CHAIRMAN. Fine, if the colonel will proceed.

STATEMENT OF LT. COL. W. D. SYDNOR, OF AIR DEFENSE DIVISION, IN DIRECTOR, SPECIAL WEAPONS, OFFICE OF CHIEF OF RESEARCH AND DEVELOPMENT, DEPARTMENT OF THE ARMY

Colonel SYDNOR. Mr. Chairman, with your permission, I would like to stay up here as much as possible to get a little closer sense of communication with you and then direct your attention to the pictures.

The CHAIRMAN. You may come up to the elevated level or right here beside Mr. King.

Colonel SYDNOR. If I may stand here, sir, I believe it would be best, and we could see.

The CHAIRMAN. All right.

Colonel SYDNOR. As General Dick has told you, sir, we have been in active development on the Nike-Zeus system for about 3 years * * *

What I would like to cover is a description of the system, and the main thing I would like to point out here and get across is that this is not just a missile, it is a greatly integrated system. Then I have a movie that will give you, I hope, a good idea of where we stand hardwarewise.

The first slide, if I may have it.

I would like to point out in the upper left-hand corner, the targets of the system which as mentioned, is designed to combat all forms of the air threat, ICBM's, IRBM's, and other air-supported targets. * * *

We can achieve intercepts against air-supported targets at whatever altitude they themselves are capable of flying, * * *

The CHAIRMAN. Well now, if you would tell the committee in executive session briefly how far have we really gone in the development of that missile.

Colonel SYDNOR. Sir, I hope my presentation here will bring that out, because it has so many pieces, and we are at different stages with the various pieces. May I clarify it afterwards?

The CHAIRMAN. Yes; you may proceed.

Colonel SYDNOR. The missile uses a solid propellant in both the motor and the booster. The problem of antimissile defense is similar to the antiaircraft problem except for two things: The target is very, very small, and it is very very fast, * * * So our intercept is similar to what we have on Hercules, but the pickup and tracking problem is the major problem. * * *

The next slide will show how this * * * is used.

To explain it, I would like to start with the typical engagement by assuming the enemy warhead, coming in from the right-hand side of the picture. We show early warning as being the first thing that the continental United States gets. * * *

Mr. ANFUSO. Mr. Chairman, could I ask a question at this point?

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Colonel, we are dealing here in a matter of seconds?

Colonel SYDNOR. That is correct, sir.

Mr. ANFUSO. That would mean we would always have to be on the alert?

Colonel SYDNOR. As I pointed out, sir, if we have an early warning system like the Air Force BMEWS early warning system, that operationally turns out to be 100 percent dependent, we could be perhaps on a 10-minute alert. If we don't have that, we would have to be continuously on the alert. * * *

Mr. ANFUSO. And you would have to have plenty of these defenses all over the United States; wouldn't you?

Colonel SYDNOR. * * * Therefore, depending on how many of these areas you have, this is how many batteries you would like to put in.

As General Beach pointed out, we think we should have a priority list and put the first one in No. 1, the second one in No. 2, and so on, to whatever extent the budget—and so on.

Mr. ANFUSO. With New York City No. 1, of course?

Colonel SYDNOR. I don't know where all of you gentlemen are from, so I wouldn't like to answer.

The CHAIRMAN. * * *.

Colonel SYDNOR. * * *.

The CHAIRMAN. * * *

Colonel SYDNOR. * * *

Mr. FULTON. * * *

Colonel SYDNOR. * * *

Does that answer your question?

Mr. FULTON. Yes. * * *

Colonel SYDNOR. Well, it has to——

Mr. FULTON. Thank you. That is enough.

Colonel SYDNOR. Now to get a better picture—this is schematic—the way one battery may look when it is deployed, the next slide shows what we have recommended as the initial type battery. * * *

Now we can successfully engage as many targets as we have missiles. The ultimate number would depend upon the number of missiles we decide to put in each battery. * * *

I would now like to describe in a little more detail the individual major components of the system.

The next slide shows the missiles themselves. * * *

Mr. MILLER. * * *

Colonel SYDNOR. * * *
General DICK. * * *
Colonel SYDNOR. What did I say?
General DICK. * * *
Colonel SYDNOR. * * *
The CHAIRMAN. Those have not been tested yet, then?
Colonel SYDNOR. That is right. * * *
The CHAIRMAN. Coming back to the original question about the Zeus, is that the reason they have not built up production facilities and not authorized building them up, because the missile has not yet been tested?
Colonel SYDNOR. Sir, the only stated reason I have seen is because—I can't quite quote it—the R. & D. has not reached the stage to warrant the expenditure of this money at this time. Nobody has said it is the missile's fault. Nobody has said it is the radar's fault. Nobody has said it is the computer's fault.
The CHAIRMAN. R. & D. is sufficiently assured to feel that missile will work to go ahead and build up the facilities?
Colonel SYDNOR. The Army so feels. That is our position.
Mr. FULTON. Do you correlate your test program on the Nike-Zeus missiles in connection with the lead-time required for the production facilities?
Colonel SYDNOR. * * *
Mr. FULTON. Well, the lead time on your production facilities or your site facilities is probably 6 months or a year. * * *
Colonel SYDNOR. Yes, sir. * * *
Mr. FULTON. * * *
Colonel SYDNOR. That is correct.
The CHAIRMAN. And during that interval we have no defense whatsoever to missiles, ballistic missiles?
Colonel SYDNOR. That is correct, * * * will be here * * * beforehand.
The CHAIRMAN. Your idea or the Army's idea is that the threat is so serious that we are justified in taking a reasonable risk to go ahead to production for that?
Colonel SYDNOR. * * * the risk of whether it really works like we think it is going to, will decrease with time. The risk to the country, of course, increases with time.
Mr. KARTH. Mr. Chairman. This might be an academic question, Colonel, but I would be interested in the answer. * * *
Colonel SYDNOR. * * *.
Mr. KARTH. I see. One other question, sir——
Colonel SYNDOR. Actually the missile itself is destroyed in flight.
Mr. KARTH. * * *.
Colonel SYDNOR. Sir, all through warfare there has never been an ultimate weapon, offensive or defensive. A lot of things have been conceived. None will be implemented until there is something to use them aaginst.
Now some of the things that have been conceived in an antimissile system penetrate or are the use of electronic countermeasures in the enemy's warhead, the use of decoys that can take many shapes and sizes, spray hundreds of objects out in the air, and the poor old de-

fense doesn't know which one has the "Toni", which one to shoot at, and it has to use up all of its missiles shooting at all of them.

Some of these things are possible next year. Some of them aren't possible until 10 years from now. None are probable unless we build a system, because only this forces the enemy to do it. * * *

Now we have deliberately designed the system with as much flexibility as we know how to allow newer techniques to be integrated into it when they are discovered. Now it is going to be the old measure-countermeasure race that we have always been in. * * *

Mr. FULTON. * * *.

Colonel SYDNOR. * * *

The CHAIRMAN. How much more do you have, Colonel, on your chart?

Colonel SYDNOR. I have three more charts, sir.

The CHAIRMAN. If you could go through them now, I think we would have enough time before the vote over there, or that may be adjournment.

All right, proceed.

Colonel SYDNOR. * * * I have a film which is 6½ minutes, that will give you an idea of what these things look like in the metal and the various things in the future.

The CHAIRMAN. Why not see the film then, so the men in charge of that could be released and then not have to come back.

Mr. FULTON. I have just one question.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. * * *.

Colonel SYDNOR. * * *.

The CHAIRMAN. Any further questions? If not, let us proceed with the other film.

(Film started.)

Colonel SYDNOR. Western Electric is the main contractor. Bell Telephone is taking care of the R. & D. program. I am sure you cannot read all of these, gentlemen. It just gives an idea of who is included at the moment. We have covered a good deal of the country with our work.

Goodyear is doing a good deal of work on this. * * *.

General DICK. * * *.

Colonel SYDNOR. * * *.

That completes this part of the presentation, gentlemen, and of course we are available for any questions that you might have.

The CHAIRMAN. Well, any questions?

Mr. FULTON. Mach * * * is how many miles per hour?

Colonel SYDNOR. Sir?

Mr. FULTON. How many miles per hour is mach * * *?

Colonel SYDNOR. Well, sir, it depends on the altitude.

Mr. FULTON. That is what I am really getting at, but what is your operational speed when it is up for intercept?

Colonel SYDNOR. * * *

Mr. FULTON. * * *

Colonel SYDNOR. * * *

Mr. FULTON. * * *

Colonel SYDNOR. * * *

Mr. FULTON. * * *

Colonel SYDNOR. * * *
Mr. FULTON. * * *
Colonel SYDNOR. * * *
The CHAIRMAN. The problem is not to step up the speed. The problem is to intercept the missile.
Colonel SYDNOR. Yes, sir.
The CHAIRMAN. To have enough time to intercept it.
Colonel SYDNOR. Yes, sir; that is correct.
The CHAIRMAN. All right, I think we could finish with the executive session now. It is quarter to 1; what is the pleasure of the committee? Do you want to adjourn until 2:30 or we can go ahead now and finish up. I think it would be preferable now. It is all fresh on our minds.
Are there any questions now? Mr. Ducander, nobody on the committee has a question. Do you have one?
Mr. DUCANDER. No, sir; I think they are questioned out.
The CHAIRMAN. I want to ask you a question, too. In reference to pushing this program now I think we have cleared it up pretty well. The Army recommended going ahead with the program, but somewhere along the line it was stopped, that is substantially correct, is it not?
General DICK. Yes, sir.
The CHAIRMAN. * * *.
General DICK. * * *.
The CHAIRMAN. At the earliest or the latest?
General DICK. At the earliest.
The CHAIRMAN. * * *.
General DICK. Yes.
The CHAIRMAN. It would take $600 million.
General DICK. Yes; more in future years. It would take about $30 million now.
The CHAIRMAN. And $700 million next fiscal year.
General DICK. Yes, sir.
The CHAIRMAN. What about following that, the year after that?
General DICK. * * *.
The CHAIRMAN. Is that much more expensive than the other features of the missile program?
General DICK. Offhand I do not recall the cost of the Hercules program. It is not as large as some missile programs. It is larger than most of the Army's antimissile or antiaircraft programs.
The CHAIRMAN. * * *.
General DICK. The missile itself is not expensive as missiles go. The major cost, if I may speak off the cuff, is in the development and manufacture of the more complicated elements of the system, the powerful radars, and then, of course, you have the question of land acquisition costs. I do not believe I can give you off the top of my head the exact breakdown of the ultimate cost.
The CHAIRMAN. Is the land acquisition cost very large?
General DICK. I would not like to guess, Mr. Brooks. I would rather furnish that to you.
The CHAIRMAN. Is it possible for you to furnish the committee that information?
General DICK. We will do that.

The CHAIRMAN. Would that cost be classified?

General DICK. Yes.

The CHAIRMAN. So would you furnish that to Mr. Ducander and any member of the committee who wishes that information would have it available from Mr. Ducander. Do you have a question, Mr. Fulton?

Mr. FULTON. Is there not a possibility there are alternative methods that are cheaper? * * *

General DICK. * * * The main problem, though, is the time limits. We are convinced that this system is at least 5 years ahead of any substitute or alternate system.

The CHAIRMAN. Any further questions? If not, thank you very much, General, both of you generals, for coming here and helping us. We appreciate very much the value of the testimony you have given us.

If there is no further business, then the committee will stand adjourned until tomorrow morning at 10 o'clock.

(Whereupon, at 12:50 p.m., the committee recessed, to reconvene at 10 a.m., Tuesday, February 10, 1959.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Tuesday, February 10, 1959.

The committee met at 10 a.m., in room 356, Old House Office Building, Hon. George P. Miller temporarily presiding.

Present: Representatives Brooks (later), McCormack, Fulton, Miller, McDonough, Anfuso, Sisk, Mitchell, Quigley, Hall, Wolf, Karth, Daddario, Moeller, King, and Roush.

Mr. MILLER. In the absence of the chairman, the committee will be in order. I am informed that the chairman will be a little late. In order to get on with the meeting we will start now.

The first witness will be Rear Adm. J. T. Hayward, Director of Research and Development. Admiral Hayward.

Admiral HAYWARD. Mr. Chairman, when the committee adjourned last Wednesday, Admiral Raborn, head of the Polaris project, finished his presentation in executive session. To resume the Navy briefing today, I suggest we hear first Captain Wagner whose subject is the Pacific Missile Range and whose testimony can be heard in open session.

Following his presentation, I would stand ready to answer further questions the committee may have that can be properly handled in open session. We would then proceed to closed session. If you wish to question Admiral Raborn on the Polaris project, I will arrange to have him here at that time. Following that I have two classified projects to cover, the navigation satellite and another satellite.

Mr. MILLER. Well, we will proceed to hear the Captain then.

Admiral HAYWARD. All right.

Mr. MILLER. And we would like to hear Admiral Raborn.

Admiral HAYWARD. We will get him in closed session then. Captain Wagner.

STATEMENT OF CAPT. E. O. WAGNER, COORDINATOR OF MISSILE RANGES, OFFICE OF DEPUTY CHIEF OF NAVAL OPERATIONS (AIR)

Captain WAGNER. Mr. Chairman, gentlemen, in order to take care of the increased load in the ballistic satellite field we have had to expand our national facilities. We now have three national ranges, the White Sands Missile Range operated by the Army, the Atlantic Missile Range operated by the Air Force at Canaveral, and the Pacific Missile Range operated by the Navy on the west coast.

The Pacific Missile Range differs somewhat from the other two in that in addition to normal routine R. & D. activities it will include training for missile firing fleet ships and aircraft squadrons and also furnish training to ballistic missile units based at Vandenberg Air Force Base for training.

The other big difference, of course, is that it will become in fact an operational facility in direct support of the fleet with the introduction of military type satellites when they become operational and the range is completed. The big difference right now is that this range is under construction and is not very operational at the moment. The guidance for this range was handed down by the Secretary of Defense with instructions that it should support only approved missile projects, but we should also make provision for the introduction of satellites and space vehicles. This posed a considerable planning problem because in developing a range sometimes the facilities on the range have a longer lead time than the missiles themselves. So, in reviewing this we realized that we had a responsible job and we had to think big and we had to look forward.

On this basis we broke out the crystal ball, dusted it off, and took a big look. I would like now to present this look which is our tentative master plan. The first chart, please.

The heart of the Pacific Missile Range is at the Naval Missile Center at Point Mugu. This is the nucleus from which we are to expand. We will expand its facilities to take care of the added load. We will take its sea range which is now a little area of 125 by 250 miles and expand it to an area of 500 by 1,500 miles. We will build an IRBM range out to 1,500 miles with underwater impact location systems. We will have three ICBM impact targets, at Midway, Wake, and Eniwetok. The layout can be projected to 10,000 miles or more into the Indian Ocean if required in the future.

In addition to these basic facilities we will require for a polar orbit range, an equatorial orbit range, an antimissile range and a satellite recovery area for both polar orbits and for equatorial orbits. The latest thinking we have on the equatorial range is that NASA will take this over.

On the antimissile range the Army is now planning to move into Kwajalein and Johnston Island, which will become closely integrated into the PMR in that area. In order to give the necessary flexibility and allow us to take care of the unexpected, we are planning to evolve a fleet of 12 fully instrumented range ships which we can station throughout the area to do what becomes necessary for different jobs as they come up. Also not shown here is the necessity to provide a launching facility for nuclear-powered satellite vehicles.

Now, I would like now to show you where we stand and how we propose to attack this overall master plan.

Mr. MILLER. Now this is at Point Mugu.

Captain WAGNER. Yes, sir.

Mr. MILLER. How far is Point Mugu south of the Vandenberg Air Force Base?

Captain WAGNER. I have a chart to show this. Point Mugu is located here on this chart and is the nucleus from which we will begin the development of the master range. This naval missile center at Mugu has been in operation for some 12 years and we are taking

this background of experience of some 5,000 naval personnel, both military and civilian, as the nucleus to grow into the major complex. This [pointing to chart] is the beginning of the sea range which is now, as I said, 125 by about 250 miles which we will expand. Up the coast we come to what used to be known as Old Camp Cook, an Army facility which was turned over to the Air Force and the Navy. The upper two-thirds of it is now known as Vandenberg Air Force Base. The southern one-third is now the Naval Missile Facility, Point Arguello.

Vandenberg is a SAC base for training, as you know. The naval missile center here will be the big step in developing the Pacific Missile Range. It is from here that the major ballistic missiles and the new family of satellites and space vehicles will be fired. You will notice that the geography here is east and west which allows a polar launch to the south to go directly over nothing but ocean from here to the South Pole. This is the major reason why this site was selected, to make it safe from the more populated areas down the coast.

The next chart shows that the terrain of the Point Arguello facility is rather rough and mountainous. These hills are 2,500 feet high and the canyons lend themselves well to security from observation for classified shots and also protection from blast for the larger thrust engines we will be developing in the next few years. The surveillance radars and communications and other instrumentation will be on the top of these hills.

In more detail the next chart shows the siting of the various facilities in the naval missile facility area, such things as public works building, transmitter buildings, radio receiver building range operations, telemetry building, tracking radars, and launching complexes. The areas in blue are by and large nearing completion. The others are still in the planning stage and just beginning.

This area down here called Sudden Ranch is a large ranch owned by a Mr. Sudden, with whom our authorities have been negotiating for purchase. We would like very much to acquire this to get a clear shot. Right now we have negotiated with him for overfly rights and to help him to evacuate some of his cowhands whenever we will shoot over the ranch.

Now to put the whole thing in a little better focus I would like to go over briefly on the next chart what the 1960 budget is going to buy for us. This probably will give you a fix as to just where we stand in this development.

Coming back to Point Mugu we will give it a new headquarters building and other facilities to carry the increased load and we will expand the sea test range to an area of 260 by 500 miles. That is the first good-sized increment toward the larger area that I mentioned before. We will improve the impact area of the IRBM range; incidentally, you will recall one missile has already been fired into this range here.

As we stand now, the Wake Island impact area is virtually complete, but the 1960 budget will complete the impact areas at Eniwetok and Midway to complete the whole complex of the ICBM ranges, with communication links which we use for clearing the areas before firing and for reporting back on the results. It will initiate the polar orbit launching facility at Point Arguello and it will provide 1 partially

instrumented launching ship, the first of the 12 that I mentioned to do this job.

The tab on this particular budget here is $126 million.

I thought it would be interesting to review the various budget levels that have gone into the facility at Mugu and how these are increasing to take care of the Pacific Missile Range. In 1956 it was $30 million; 1957, $26 million; then $42 million, and from here on it goes up at about $40 million a year increase. This is a very conservative guess. The demands we think are going to be much larger than that.

This cost includes new construction, operation, maintenance, and salaries. This, incidentally, is beginning to pose a rather difficult problem under the total ceiling budget. As these figures get larger it means that the Navy has to reprogram within its overall budget ceiling to take care of these increasing projects. This is a problem now under the Secretary of Defense to determine how best to pay for these facilities. These sums will get so large that they will become a national problem in the next few years.

I am trying to put everything in perspective by showing the White Sands Missile Range 1960 budget is $80 million, the Pacific Missile Range budget is $126 million, and Atlantic Missile Range, Canaveral, is $127 million, for a total of about $333 million to support the total project costs of the national missile and space program of $6.7 billion. This works out to a shade less than 5 percent of the total bill. Actually the national program is more than $6.7 billion, but this is as close as we could draw the line because these projects are so vast that they induce other costs. This is a thumbnail sketch, sir, of the situation at the Pacific Missile Range.

The CHAIRMAN. Thank you very much, Captain. Now, questions. Mr. McCormack.

Mr. MCCORMACK. Can you give us any idea what the leadtime, generally speaking, is in our country in comparison with the leadtime in the Soviet Union, Admiral?

Admiral HAYWARD. It will be hard to give you a definite answer, Mr. McCormack.

Mr. MCCORMACK. You notice I said a general idea.

Admiral HAYWARD. Yes. Well, if you go back over past history such as aircraft it takes us from 5 to 7 years to get it from conception to operation. With our big missile systems we do not have any system yet to really say what this would be. We have the Thor experience, but—I could give you some answer for the record——

Mr. MCCORMACK. Is the leadtime longer here as a rule than in the Soviet Union?

Admiral HAYWARD. Well, on some of the aircraft they have surprised us; yes, sir. Our judgment, of course, is based on what we have learned. We do not know how long they have been working, for instance, on the MIG series. They come out with a new model in short order. I have the feeling that it is longer here, Mr. McCormack. I cannot justify it at the moment with any definite figures.

Mr. MCCORMACK. I realize the difficulty, but the information I have is pretty much along the lines that you have answered

Admiral HAYWARD. Well, Dr. Livingston wrote a good article from Harvard on leadtime in the United States which you may be

familiar with, which gives a pretty good analysis of the problems that face us.

Mr. McCormack. I realize that, but on practical projects or activities, that leadtime could be important, could it not?

Admiral Hayward. Yes, sir. We have done this on the Polaris program, for instance. The initiation of the Polaris program, actually, of course, was in 1956, as I remember it, and we have chopped the leadtime down on that whole system from 1963 to 1960.

Mr. McCormack. The Polaris—the estimated maximum distance, as I remember, was about 1,500 miles; was it not?

Admiral Hayward. Yes, sir, that is the answer.

Mr. McCormack. Now, you are concentrating on a 900-mile——

Admiral Hayward. I would rather answer those questions with Admiral Raborn in closed session. This is not true what you read on that.

Mr. McCormack. Well, my questions are based on what I read in the papers. Without asking you anything further, you have said that what is carried in the papers about the directions to limit it to a 900-mile radius is not correct.

Admiral Masterson. Could I answer that, Mr. McCormack? Mr. Holaday put out a release on that last week. Our objective has always been in the neighborhood of 1,200 miles for the speeded-up program. That is sufficient to meet our requirements.

The Chairman. Mr. Fulton.

Mr. Fulton. I am glad to have you here again, Admiral. We have had testimony by the Army as to the development of antimissile missiles and of a radar screen, both pretty costly, to meet the threat of ICBM's. Does the Navy have a program for, first, detecting ICBM's that might be hostile, and, secondly, does it have a program for knocking down or diverting such hostile ICBM's that might be fired in the direction of the United States or the free world?

Admiral Hayward. Mr. Fulton, I will answer that in detail in closed session. In other words, the Navy is in the A.S.W. business. If a missile comes from the sea, we have to be in a position to knock it down, because we are working on the good side of the trajectory, but I would rather go into details in closed session.

Mr. Fulton. So your program is really directed at a missile that might come out of the sea, an ICBM that is antagonistic to the United States, rather than a land-based missile.

Admiral Hayward. That is correct, Mr. Fulton.

Mr. Fulton. You are not, then, developing an antimissile missile in competition with the Army's announced system, are you?

Admiral Hayward. No, sir.

Mr. Fulton. Could you comment for us on what the Navy is doing in that field and, of course, I must add within the strict grounds of security, because I have some knowledge——

Admiral Hayward. I would comment on that in closed session.

Mr. Fulton. All right. The question comes up whether the White Sands Proving Ground, the Atlantic Missile Range, and the Pacific Missile Range are all necessary, or is that an overlapping construction?

Admiral Hayward. I would say they are all necessary; yes, sir. They have different jobs to do. At Cape Canaveral, of course, the Atlantic Missile Range is primarily the R. & D. range. You must

remember that you cannot fire a polar orbit from Cape Canaveral and you have to have a place to train the actual enlisted men of all of the services really in the use of these missiles, and you could not saturate Patrick or the Atlantic Missile Range this way, or you would not have any R. & D. work done.

Mr. FULTON. The Atlantic Missile Range is necessary now because it has a range of 4,000 or 5,000 miles.

Admiral HAYWARD. That is correct. It is 4,400 nautical miles to Ascension.

Mr. FULTON. At the White Sands Proving Grounds, could you tell us what they do there that is not possible at the other bases?

Admiral HAYWARD. Of course the Army runs that. My knowledge is based on when I worked out in that area. Usually they did the first part of the trajectory X, Y, and Z, in Space versus Time of these missiles up to a hundred miles and there was an awful lot of work to be done, for instance in the Talos business that we have on our ships, that this was the only place we could really do it. I would rather defer to the Army, Mr. Fulton, to answer that.

Mr. FULTON. My final points are on budget. There is, of course, a budget ceiling on the Navy as on every service. You may have to reprogram your plans for the fiscal year 1960 and possibly cut out some things from what we always refer to as the "shopping list," from what you would like to have.

Could you explain to us the effect of this budget ceiling that has been put on the Navy for the fiscal year 1960 with regard to the research and development program. Refer especially to how much room you are going to have in your Research and Development Agency in the Navy, which you head, for basic research. May I just finish with a comment on that. Last year, when we passed the act, a large part of the work was done by this committee. Our then chairman, Mr. McCormack, as well as our present chairman, Mr. Brooks, and myself, have felt there should be room in the military services for broad programs and progressive programs for basic science that are not budgeted on the basis of immediate application to weaponry systems.

Now, in order to carry out that general basic objective, what room do you have in the 1960 budget? Would you comment on that? And where, if it pinches, could this committee help you, because our jurisdiction generally is science generally, covering military as well as civilian at this point.

Admiral HAYWARD. Well, to begin with, it has been Admiral Burke's policy for the Navy to not reduce the basic research on the applied research side of the programs. Last year in Congress we got an additional $15 million for basic research. We got this from the Secretary of Defense actually, and we have kept the same level this year as that increased level of last year in the basic and supporting research part of the program.

As you know, I am a program sponsor and Admiral Burke would be probably most unhappy with me if I ever said I had enough money. I have to compete and he has to make the decisions for the rest of the Navy. We are at a constant dollar level in these 2 years really and because of inflation naturally you do less in some areas. We have tried to stick to the areas that look most promising, but in

the budget formulation he is the man who has to make the decision on what he does, of course, and does make the decision as to how much will go into R. & D.

Now in the Navy we do have a system where we have money, where our scientific people can do exploratory research. It has no application, whatsoever, to any program. We have them in the solid state physics; we have them in straight physics, low energy physics, high energy physics. We have quite a large program.

As I told you the other day, we have 1,500 contracts with various universities and nonprofit institutions, roughly 1,500, in which this is being done.

Now, to give you an idea of this work we have done in the Navy, particularly the Office of Research, Admiral Bennett's people, from the years of about 1947 to 1954, 39 percent of the doctorates in this country that were given in the physical sciences were in some way or other aided and supported by ONR projects in these basic fields. We feel very strongly in the Navy and have always felt that we have got to do this in the service or we run out of what I call our seed corn. So naturally I could use more money in basic research.

Mr. FULTON. How much money would you consider as necessary for basic research programs for the Navy in the budget for the fiscal year 1960 that you did not receive, that is, your own personal judgment?

Admiral HAYWARD. Well, I will give you that answer for the record. That is on the basic and applied side. We had a true requirement of $770,733,000 for all R. & D., that is including the systems. Of this, there was $422 million in what we call the part 2 of the budget which is the basic applied and supporting research. Under the $522 million program which I finally got, there is $322 million of it in this basic applied and supporting research. So that would mean $100 million was cut out of that side of our R. & D. program in this budget process.

Mr. FULTON. How many echelons of command are there above you on R. & D. projects, and space projects particularly, before you can get a go-ahead signal?

Admiral HAYWARD. Well, in the Navy, of course, I work directly for Admiral Burke. Under the Navy system, we have the deputies of the Navy sit as a board on all of the budget. Once I get an R. & D. figure such as the $522 million, this is presented, of course, to the Department of Defense, Assistant Secretary of R. & D., Dr. York.

Mr. FULTON. I was going to say do you go to Dr. York, Mr. Holaday, or Mr. Johnson? How do you arrange that?

Admiral HAYWARD. Well, let me say if I have a system in R. & D., I would present it first to Dr. York. Dr. York might present it to Mr. Johnson or he might refer it to Mr. Holaday. However, I believe that Mr. Holaday's division is now a part of Dr. York's shop. I am sure of it actually. Dr. York would be the man who gave us the technical decision. He is a very fine scientist, and he is my direct contact in the research and development side.

Mr. FULTON. Practically, then, where does Roy Johnson fit into this picture on authority?

Admiral HAYWARD. If it were a space program, for instance, Dr. York would refer it to Mr. Johnson, but I would get the go-ahead from Dr. York.

Mr. FULTON. You would not put it through the Civilian-Military Liaison Committee, established under the Space Act, before you got the go-ahead, would you?

Admiral HAYWARD. Well, this depends on the funds. If it is ARPA's funds, for instance, it would be coordinated; as I am an alternate member of that committee, for instance, I would certainly know what NASA was doing. I would not put it through them; no, sir. Dr. York might. As the head of R. & D. for the Navy, he would be my contact.

Mr. FULTON. Then, finally, you would not put it through the National Aeronautics and Space Council, either?

Admiral HAYWARD. I would not; no, sir. Dr. York might. He might be required to present the Department of Defense's programs to the Space Council for Mr. McElroy.

Mr. FULTON. And you would not have direct contact with the National Security Council.

Admiral HAYWARD. No, sir.

Mr. FULTON. But the Security Council would still have a veto on your programs, too, would it not?

Admiral HAYWARD. They have a veto on any program, yes, as far as I am concerned.

Mr. FULTON. So that actually you have about 10 various places that can veto you.

Admiral HAYWARD. This is correct, yes, sir.

Mr. FULTON. And you go up about four steps within the Department of Defense, do you not, on a space program or a basic research project?

Admiral HAYWARD. Yes, sir, I go to my immediate superiors in the Navy, of course, Admiral Burke. We present it to the Department of Defense, and then, of course, the system, as I said the other day, you have these four things you have to remember. Appropriations, obligations, apportionment, and expenditure.

Now after the appropriations are made, they come back again. I, once again, to get my apportionment, have to justify my program.

Mr. FULTON. Yes, and you have to justify it likewise to the Secretary of the Navy and also the Comptroller of the Department of Defense, who takes a slice out of it.

Admiral HAYWARD. Yes, sir, that is correct.

Mr. FULTON. Well, how do we get out of this maze of places where all these programs go to where so many people have the right to veto and say "no" and such a hard path to get a "yes"?

Admiral HAYWARD. Well, Mr. Fulton, speaking for myself, and I have had General Trudeau and Lieutenant General Wilson, who hold the same position in their respective services, it is not the veto that bothers us so much as the fact that we should only have to go one place to get technical approval, and this is the place that we hope Dr. York fills.

Now, if the Comptroller wants to do anything because of expenditures or budget, it should not be a technical review. The Comptroller is not in a technical business, and I would certainly be willing to abide by any decision that Dr. York made technically.

Mr. FULTON. So, really, the Bureau of the Budget should not act technically either.

Admiral HAYWARD. No, sir, this is correct.

Mr. FULTON. But they likewise can take a slice at you, can't they?

Admiral HAYWARD. This is correct, but from the technical appraisal, we feel that we should only have one competent technical agency to go to, which is Dr. York. This was the idea of the legislation and the reorganization, which I was glad to see.

Mr. FULTON. Now, when the Army witnesses were here yesterday, they said they couldn't tell who it was that was advising the Department of Defense, the Secretary of Defense, against some of their programs. When the decisions were made, I asked who this group of ghosts are that are able to say "no" when the Army feels there should be a "yes" on a vital security program for Army purposes.

Do you have that problem? You can't tell who says "no" to you when you get up so high and run into a bunch of advisers or a committee of advisers in the Department of Defense?

Admiral HAYWARD. I have no difficulty finding out who says "no."

Mr. FULTON. The Army couldn't even find out who said "no."

Admiral HAYWARD. Dr. York is the technical adviser, of course, to Mr. McElroy and to Mr. Quarles. Mr. Quarles is a very competent technical man himself. I know where the "no" is, Mr. Fulton.

Mr. FULTON. And it is hard to find where the "yes" is.

Admiral HAYWARD. Well, I will put it this way: If you get a "yes" at a certain level, it doesn't mean that the program will go. You have to get a "yes" from Dr. York, and you have to get a "yes" from the Secretary of Defense.

Mr. FULTON. My final question is, does the getting of the "yes" from these various levels take too much time? This is supplemental to the question Mr. McCormack has been asking. Is the administration so complicated that it takes a lot of time just simply to work through it before you can get the program in, and going?

Admiral HAYWARD. My answer to that would be "yes," it is complicated. I want to make clear, however, Mr. Fulton, that having Dr. York in his position is a tremendous help to us for the simple reason now I have a competent scientist, I have a competent technical man, and I can fight with him on his own grounds. With the Comptroller this is difficult in the technical field.

Mr. FULTON. We are trying to simplify the space and science programs so that we can get good, efficient, executive approach and quick decisions. When it started out, Dr. von Braun was before us last year, and I believe testified he had 23 levels of decision to go through before he could get a final "yes" on a research and development program.

Thank you. That is all.

Mr. MILLER. Well, Admiral, as I follow Mr. Fulton's comments, it used to be then that you had to fight with the Comptroller's nontechnical people. So now, instead of throwing to first base, it becomes Hayward to York to the Comptroller, isn't that true, just relaying the ball?

Admiral HAYWARD. No, sir. Our hope, of course, is that Dr. York has enough stature in the Department of Defense that when he gives a technical "yes," it will be a "yes" for the Department of Defense. This was our whole assumption and the way the law reads to me. He has this authority.

Mr. MILLER. I hoped that that was the case, but in your experience in the Navy, no matter how we try to soften this thing, and in the Defense Department generally, doesn't it always resolve itself down to the fact that you are limited to the man who actually says "yes." He is the fellow who merely looks at the debit and credit side of the ledger. It comes down to the Comptroller finally; isn't that so?

Admiral HAYWARD. No. If in my program of $525 million I see it would be better to shift from one project to another project I would propose it. Now, before you had a real good technical man who understood what you were doing, if you did this shifting, the Comptroller was likely to say, "Great, we will take the money from project 39, but we won't put it in project 30." Whereas, the technical man will say, "That makes good technical sense to take that money from 39 and put it in 30."

Now, if Dr. York says that to the Comptroller—because you must remember this is all within the confines of the overall program, which is the flexibility which we would like to have. Now, if there is any doubt in my mind if I cancel 39 to go into project 30, that the Comptroller is going to take the money, the human reaction would be not to do this.

Mr. MILLER. Not to cancel it?

Admiral HAYWARD. That is right, not to cancel it.

So in discussing this with Dr. York, he understands our problem, and I think under the existing law and organization that he has the authority to do just that.

Mr. MILLER. In other words, you now have a contact directly with the Secretary of Defense?

Admiral HAYWARD. This is correct. Dr. York has an open door to me, and to General Trudeau and to General Wilson. We can walk in his office any time, and we meet every 2 weeks, together with our Assistant Secretaries for R. & D., and we are his counsel really, so we do have an opportunity to do this.

Mr. MILLER. This is an opportunity you haven't had before?

Admiral HAYWARD. Yes, sir. I don't know whether the committee realizes what a tremendous thing it is in Government to get such a competent physicist as Dr. York.

Mr. MILLER. I want to say that I agree with you, and coming from a district in which Dr. York did some of his greatest work—the Livermore Laboratory happens to be in my district—I join you in paying compliment to him and to his competency.

Admiral HAYWARD. You see, our problem before has been that we didn't have the technical competency at that level. We have it now, and I think anybody in the scientific world will agree. I only hope we can keep him.

Mr. MILLER. I am very hopeful that having obtained Dr. York, you will still retain the vigor and the ability to battle down this rather solid individual which may masquerade in the white sheet of a ghost, but isn't a ghost at all. It is the Comptroller of the Department of Defense.

I have no further questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Chairman.

I think the ground has been very well covered. I should like to make a request of you, anyway.

Is it possible to get the different branches of the service, as well as our space agency, to furnish us charts depicting the different echelons they must go to in order to get a decision and also the time that has been consumed on previous decisions?

The CHAIRMAN. I understand we are already engaged in collecting that. Our staff is working on that.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Furthermore, I will say this: I believe some of these questions can be cleared up when we get the Defense Department here.

Mr. FULTON. We are doing pretty well there.

Mr. SISK. I have just one question.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. We were discussing this chain of command and who can say "no" and who can say "yes," Admiral Hayward, and discussing particularly Dr. York. I, personally, would like also to pay tribute to Dr. York's capabilities. Certainly, I know from personal experience with him that we do have a man that is really capable.

But now, who is Dr. York's boss?

Admiral HAYWARD. Mr. McElroy.

Mr. SISK. Where does Mr. Roy Johnson fit into the picture? I thought Mr. Roy Johnson was head of ARPA.

Admiral HAYWARD. He is the head of ARPA, yes, sir.

Mr. SISK. Well, how is Dr. York connected with ARPA?

Admiral HAYWARD. I would have to get the reorganization law and read it. It is quite direct in the law. Dr. York is the most powerful man in the Department of Defense from my point of view. He has the authority, as I understand the way the law reads. He comes directly under the Deputy, Mr. Quarles, and Mr. McElroy, the Secretary.

Mr. SISK. I appreciate the fact, and I understand.

Admiral HAYWARD. Now, there is one difference with ARPA, you must understand. ARPA is the only part of the Department of Defense that really has money for programs. You see, ARPA has its own funds.

Mr. SISK. That is right.

Admiral HAYWARD. That is the difference between any of the other sections of the Department of Defense. ARPA has its own projects, the Advanced Research Project agency runs the WS–117L vehicle, for instance. It has helped us in some of our fields. It gave us some programs using the services, but they have the actual money themselves, and it is not part of my $522 million, for instance, in this basic program. So that is where they differ. But the relative seniority, as I read it, is Dr. York is the boss in research and development and test and evaluation. He is the man who has the authority under the law.

Mr. SISK. Well, I appreciate that they are going to be before us next week, and at that time we will ask some questions. But in line with some information that we have had recently, there seems to be some question whether Dr. York can overrule Mr. Johnson or Mr. Johnson can overrule Dr. York. Frankly, I will admit to some bit of confusion as to this chain of command. I was just curious as to what you feel, and others at your level in the picture feel, to be the

top people. In other words, who can overrule who and who can say "No?" And frankly, that was the only purpose I had in posing the question as to who was Dr. York's boss.

Dr. York, in your opinion then, is responsible directly to Mr. McElroy?

Admiral HAYWARD. That is correct; yes, sir.

Mr. SISK. Secretary McElroy has only one boss and that is the President of the United States.

Admiral HAYWARD. That is correct.

Mr. SISK. That would be the chain of command as you see it?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. Would the gentleman yield there?

Mr. SISK. I would be glad to yield to the floor leader.

Mr. MCCORMACK. Suppose Dr. York and Mr. Johnson disagreed on a matter that the Navy has jurisdiction over. What position are you in then?

Admiral HAYWARD. Well, our problem would be down fighting with both of them. That is what I would do, Mr. McCormack.

Mr. MCCORMACK. I imagine you would, but I just want to know where you stand.

Admiral HAYWARD. Well, I can assure you I would be there if they were fighting over something.

Mr. MCCORMACK. Furthermore, if the Comptroller got interested—of course where the money is the power is, you and I know that——

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. You and Dr. York might agree on technical policy, but the old money is what puts it into operation.

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. You can't make the mare go without the money.

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. And if the Comptroller should interest himself in the financial angle, then you have another phase to battle with or subject yourself to.

Admiral HAYWARD. But then I have Dr. York, who is the top man in the Department of Defense, on my side, you see, which is a tremendous help.

Mr. MCCORMACK. Oh, I am not underestimating that, but we are just trying to do a little probing of our own. We want to see how this organizational setup is.

Mr. SISK. If I could pursue that question a bit.

Let's say Dr. York was not on your side, that he was on the opposite side.

Admiral HAYWARD. He can overrule me, yes.

Mr. SISK. But you are in there fighting for your cause, and I want to compliment you now, Admiral, and say you are a great fighter for your cause. I appreciate that. I am glad we have people like you in there working on these programs, who are not going to give up because Dr. York is against you. You are going to appeal to somebody who can override Dr. York, if you firmly and vigorously believe in the program that you are working on.

Admiral HAYWARD. That is correct. And I have done this.

Mr. SISK. Who would you deal with?

Admiral HAYWARD. I would go to Mr. McElroy, myself, and to Mr. Quarles. I would go to anybody who would sit still and listen to me, even the Killian committee; anybody who would sit still and listen to why I wanted to do it.

Mr. MCCORMACK. Where might that leave you in connection with future promotions?

Admiral HAYWARD. I don't know, Mr. McCormack. We will see very soon.

Mr. SISK. One concluding question, Mr. Chairman. I would like to ask——

Mr. MCCORMACK. I don't think that question will hurt you if the case should arise. I didn't mean it to hurt you.

Admiral HAYWARD. No, sir; I understand, Mr. McCormack.

Mr. SISK. Well, because of some confusion that exists, let me ask you this: From your viewpoint, would you recommend any specific or general change in law with reference to this so-called chain of command? Do you feel that the Congress possibly should take another look at just how this order should proceed? Do you have any comments at all on that, Admiral?

Admiral HAYWARD. No, I better not comment on that, Mr. Sisk.

Mr. FULTON. Would the gentleman yield?

Mr. SISK. Yes, I will yield.

Mr. FULTON. With all this maze of command, where are the Secretaries of the various services, the Army, Navy and Air Force? In addition, where are the Joint Chiefs of Staff? What happens to them? We have almost left them out of the discussion.

The CHAIRMAN. Would the gentleman yield there?

Mr. SISK. Yes; certainly.

The CHAIRMAN. Of course ARPA is the result of a separate piece of legislation that was tied onto the Defense Act about 2 years ago. It places the responsibility directly under the Secretary of Defense. Isn't that right?

Admiral HAYWARD. That is correct.

The CHAIRMAN. Which, in effect, bypasses the Secretaries of the several departments.

Admiral HAYWARD. That is correct.

The CHAIRMAN. That is the reason why, with your chain of command going up, you would go directly to McElroy. That is correct, isn't it?

Admiral HAYWARD. Yes, sir.

Mr. SISK. Mr. Chairman, if I could interject a question here. In other words, you at no time, then, in this program, go to the Secretary of the Navy?

Admiral HAYWARD. Oh, yes, sir. I must say, you see, that my Assistant Secretary for Research and Development, who is in the Secretary's office, was Mr. Norton, and I don't know who the new one will be, but Mr. Gates—in the Navy we have this bilineal organization—he goes with me. I need one very badly, and he should be here today with me.

Mr. SISK. I think you are doing very well.

Admiral HAYWARD. But he goes with me to Dr. York and sits with the other Assistant Secretaries.

Mr. McCormack. You used the word "if," didn't you? "If he goes"?

Admiral Hayward. Well, no, sir. He can overrule me also. Yes, sir, there is no question about that.

Mr. Sisk. That was the point of my question.

Admiral Hayward. The Secretary of the Navy, yes, sir. I work for Mr. Gates.

Mr. Sisk. Well, that is the point in getting this whole chain linked together here. You first must go to the Secretary of the Navy. He actually then becomes in essence your first boss.

Mr. Miller. If the gentleman will yield, first he goes to the Assistant Secretary.

Admiral Hayward. To Admiral Burke.

Mr. Miller. Well, yes, then to the Asistant Secretary of the Navy for Research and Development, then to the Secretary of the Navy. Isn't that right?

Admiral Hayward. Yes, sir.

Mr. Sisk. Well, Admiral Burke is Chief of Naval Operations.

Admiral Hayward. Yes.

Mr. Sisk. You go to him first?

Admiral Hayward. Yes; he and Mr. Gates. In the Navy our civilian secretaries, we live real closely with them, and I can't say too much for them, Mr. Sisk, because they are our best fighters. It is a tremendous loss to us to have Mr. Gates go, because he lives with us. He knows an awful lot about the Navy. Mr. Franke does also.

Mr. Sisk. I agree with your comments.

I would just like to get clear the chain of command in the programs you propose. You would go first to Admiral Burke, or to someone who is Chief of Naval Operations at the time?

Admiral Hayward. That is correct; yes.

Mr. Sisk. Then to the Assistant Secretary in charge of your particular research and development program.

Admiral Hayward. In going to Admiral Burke, I go to the Secretary at the same time. Mr. Gates and Admiral Burke live very closely together, and when I propose a program such as my testimony on the AMP business in the joint committee, Mr. Gates came with me that day rather than Admiral Burke.

Mr. Miller. Would the gentleman yield?

Mr. Sisk. Yes; I would be glad to yield.

Mr. Miller. Now, they live closely together?

Admiral Hayward. Yes, sir.

Mr. Miller. So you talk with them as one. But suppose they were not too closely together? Suppose Admiral Burke said, "Well, I think this proposition"—we will call it 42—"is a good one," and Mr. Gates didn't think so much of it. The buck stops right there, doesn't it? Progress stops there, doesn't it?

Admiral Hayward. I don't know, sir.

Mr. Miller. But practically speaking, isn't that right?

Admiral Hayward. Well, this is civilian run.

Mr. Miller. But there is an opportunity for the Secretary to veto at that point?

Admiral Hayward. Admiral Burke has the opportunity to present his side right to the top, you see. He is also a member of the Joint Chiefs, and he has an appeal, let me say.

Mr. MILLER. He can appeal from the Secretary to Dr. York.

Admiral HAYWARD. He can appeal to the Secretary of Defense.

Mr. MILLER. Well, he would go to Dr. York, I assume, for technical approval?

Admiral HAYWARD. He probably would; yes, sir.

Mr. MILLER. Or would he go to the Secretary and the Secretary would call in Dr. York for technical advice? There is a good deal of difference between Dr. York acting as an adviser to the Secretary of Defense or Dr. York being in the echelon where he can say "No" before it goes to the Secretary.

Admiral HAYWARD. Well, maybe I should clarify how the programs are made.

We have a long-range objective plan for the Navy. We have programed objectives. These are published and worked over. They go to the Joint Chiefs, the unified commanders. Usually in this particular business of starting one particular program I don't think we have that problem that you have envisioned there. You might have it in an operational matter. You might have it in the canceling of a system, but usually in starting the programs the programs are to support a definite objective, and if the objective is changed, you might have your argument there. But usually the arguments between a Secretary and a Chief of Staff would not normally be technical arguments, Mr. Miller, I don't believe. I may be wrong. But I am no expert on organization, I assure you. The law was passed, and we have a famous saying in the Pentagon now: "If you can't cook it, kiss it, or mimeograph it; you reorganize." That is the limit of my knowledge on it.

Mr. SISK. I hesitate to pursue this, Admiral, but I do feel that in view of the confusion—and I don't know that we are going to resolve this confusion here this morning—but for my own satisfaction I am interested in just briefly the chain of command from the standpoint of authority, because someone in each case has the authority to override.

Let's take your chain of authority to the President of the United States. First is your Chief of Naval Operations, as I understand it?

Admiral HAYWARD. Yes.

Mr. SISK. Then next is the Assistant Secretary in charge of R. & D.

Admiral HAYWARD. That is correct.

Mr. SISK. OK.

Next is the Secretary of the Navy?

Admiral HAYWARD. Yes, sir.

Mr. SISK. That would be Mr. Gates. All right.

From there it goes to where, now?

Admiral HAYWARD. It will go to the Secretary of Defense.

Mr. SISK. And from the Secretary of Defense, of course, then it goes to the President?

Admiral HAYWARD. Yes, sir.

Mr. SISK. That is the top.

Now, actually these other groups which enter into the picture, such as ARPA, along with Johnson and York, are simply a part of the Secretary of Defense's organization?

Admiral HAYWARD. That is correct.

Mr. SISK. That is used to handle and orientate the program?

Admiral HAYWARD. That is correct. They advise the Secretary of Defense on his decision, and the decision is the Secretary of Defense's decision.

Mr. FULTON. They are the ones that can say "No" from the gallery seats. That is the trouble.

Mr. SISK. I will yield to the gentleman from New York.

Mr. ANFUSO. Admiral, you, as a scientist, suppose you had the OK on a project from Dr. York, but a political Secretary of the Navy overruled you, which prevented you from going any further, would you still go to the Secretary of Defense?

Admiral HAYWARD. If Dr. York approved it, he would be the man that would take it to the Secretary of Defense.

Mr. ANFUSO. He would overrule the Secretary of the Navy?

Admiral HAYWARD. Under the law, he has the authority.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Of course, you have a little bit of this situation: You have the appeal of the project in one way and yet personally you have got an obligation the other way.

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. In other words, you work under the Secretary of the Department, but the project you are working on follows a different chain of titles, isn't that true?

Admiral HAYWARD. Well, when I take it to Dr. York—when we take it to the Secretary of Defense, let us say, Mr. Chairman, the Secretary of the Navy will actually sign the letter to the Secretary of Defense. If we proposed a program such as on this nuclear propulsion business, the Secretary of the Navy writes a letter to the Secretary of Defense. I do all of the work, and he sends the letter there. Then actually I work with Dr. York directly in the overall R. & D. programs, but on specific items for approval of this kind it goes from Mr. Gates to Mr. McElroy.

Now, Mr. McElroy may take Dr. York's advice. He may not. He has this choice.

The CHAIRMAN. You get the idea of what I mean?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. You have a little bit of conflict there between personnel jurisdiction and project jurisdiction; isn't that what it is?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. Isn't that what probably is confusing a good many members of the committee?

Admiral HAYWARD. I think that is correct.

The CHAIRMAN. Because the law has set up the fact that ARPA comes under the Secretary of Defense, but now you yourself operate under the Secretary of the Department.

Admiral HAYWARD. That is correct.

The CHAIRMAN. Therefore, the Secretary of the Department uses personnel control, whereas the Secretary of Defense controls the project. In effect it works out to about the same thing.

Mr. ANFUSO. Will you yield to me, Mr. Chairman?

The CHAIRMAN. I will recognize you, Mr. Anfuso.

Mr. ANFUSO. Did I understand you to say that you must get a letter from the Secretary of the Navy to go to the Secretary of Defense?

Admiral HAYWARD. I don't mean it the way you are saying, Mr. Anfuso. I mean on aircraft nuclear propulsion or any big, large new program that we are proposing, it will be proposed—even Polaris, where we feel we have a certain need, it will be proposed in an official letter from Mr. Gates to the Secretary of Defense. Now, it has lots of implications.

As the chairman very aptly pointed out, there is the project control, there is the budgetary control. So Mr. McElroy has to get lots of answers before he approves it or doesn't approve it.

Mr. ANFUSO. Now, supposing you had Dr. York's OK, as I said before, but a political Secretary of the Navy refuses to sign that letter to the Secretary of Defense, then where are you?

Admiral HAYWARD. The Secretary of Defense can still go ahead with the program.

Mr. ANFUSO. But you can't get to the Secretary of Defense unless you have a letter from the Secretary of the Navy.

Admiral HAYWARD. That is officially correct, but it would be——

Mr. ANFUSO. Well, it could happen?

Admiral HAYWARD. Yes, sir.

Mr. ANFUSO. A political secretary, Democratic or Republican, could overrule it and say, "I will not sign such a letter to the Secretary of Defense." Then where are you?

Admiral HAYWARD. Well, I have another fight going on.

Mr. SISK. One last question, Admiral.

By the time you get one of these programs justified, do you have any time to do the work on the program?

Admiral HAYWARD. Well, I am quickly forgetting all I knew about physics, I assure you. We try to protect our working people as much as we can that work on the programs and try not to bother them too much. We are already starting on the 1961 budget, you see, and this is a continental process.

Mr. SISK. Thank you, Mr. Chairman.

The Chairman. My suggestion is this:

Of course these things disturb the committee, but we are in sort of the situation that the gentleman just referred to. If we are going to take up all of our time trying to find out from each service just how these things are processed, we may not have time to get down to our basic work.

Now, why wouldn't it be a very good thing for this committee to let the staff go ahead and work this out. Then we will have the witnesses come here and they can give us the answers. There will be no difficulty and you won't embarrass any of these witnesses in working out this. I think we would save a lot of time.

Mr. FULTON. Could I comment?

I believe the committee is doing a good job in bringing this out for the public, so that they will have knowledge of the difficulties that these scientific and research programs are going through. If we can bring pressure to bear through this examining of these various services to show that each service has a different problem, and they don't know what their echelons of command above are, and the lines are not definite on authority, and many people can say "No" without any particular responsibility, and they have to get a "Yes" every place or it doesn't go through, we will have accomplished something. Now, we are doing a job, and I think we should go ahead on it.

The CHAIRMAN. Well, all right, the Chair was simply thinking of this: We are lagging far behind in the hearing of the witnesses that we had scheduled to hear. Now, we can do this: We will be out of town several days this week. When we come back, we can just double up and have some night sessions, and catch up, or we can try to work it out in a way that will save time. Whatever the committee wants to do will satisfy me.

Mr. FULTON. And we are learning, too, I might add.

The CHAIRMAN. I think we ought to have it worked out so we know what is the trouble in each department so we can assist.

Mr. Mitchell.

Mr. MITCHELL. One question, Mr. Chairman.

Admiral, Captain Wagner in his presentation as to the Pacific Missile Range, for 3 years subsequent to now, he said he could conservatively estimate it will require some $246 million in 1963 as compared with only $126 million for fiscal year 1960.

Now, I would appreciate it if you would sort of elaborate on the reason for this increased cost for each—I assume that will be true of each of the Pacific missile ranges as well as Pacific?

Admiral HAYWARD. No, sir.

Mr. MITCHELL. It will not?

Admiral HAYWARD. No, sir. The Pacific Missile Range is just coming into being. You have those ships he mentioned. You have the instrumentation, and you must remember, as he pointed out, that the leadtime for facilities sometimes takes longer than for the actual program.

Now, a missile range such as this is at the mercy of the planners, really. You go to the Army or to NASA or to ARPA and say, "What are you going to shoot on this range in such and such a year?" They tell you. You have to plan for it. This is the same way we do in the Atlantic range. We have to tell General Yates yes, we are going to shoot so many Polaris or we have to do this or that. If there is something peculiar in that program, the program sponsor has to build that particular facility, so you can see that these are really educated guesses, and that the reason the others are not going to go up in cost is that the Atlantic Missile Range is built, and so is the White Sands, and the Pacific Missile Range is not built.

Mr. MITCHELL. When will the Pacific range be in full operation?

Admiral HAYWARD. Captain Wagner, do you want to answer that?

Captain WAGNER. It will probably be difficult to define what full operation is. It is in partial operation now, but with the normally accepted definition of the term, I would say in 1963 it should be pretty close to full operation at that time.

Mr. MITCHELL. That is all. Thank you.

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. No questions.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. No questions.

The CHAIRMAN. Mr. Karth.

Mr. KARTH. I have one, Mr. Chairman.

I was interested in the questions precipitated by Majority Leader McCormack's initial question, sir.

You and others who have appeared before the committee have pretty much agreed that the Russian technical know-how is pretty much on a par with that of the United States: that they have good scientists.

Admiral HAYWARD. Yes, sir.

Mr. KARTH. If this is true, and let's assume that it is for the moment, and if the leadtime is longer in the United States than it is in Russia, is it rather fallacious reasoning to assume that we can catch up?

Admiral HAYWARD. Well, as you remember my first statement was, as I said, the challenge was across the board, and we have to tell our people that there is no substitute for hard work, and our people are not alert to the challenge today. The newspapers say how many ICBM's the Russians have versus how many we have, and that is the only part of the challenge, but if you read in detail, take Khrushchev's last speech, if you look at the economic side, the political side, and the psychological side, we have to get to work, and this is the answer I gave the other day when they asked whether we were at war. We are at war now. These people have sworn to destroy us, but we are not just at war in the ICBM field, we are at war across the whole spectrum. This is important for the American people to know.

Mr. KARTH. Well, Admiral, in the field of missiles, do you feel that with the leadtime as it is today, that is, without the necessary appropriations to cut this leadtime and reduce this long, drawnout affair, redtape and everything else that is involved, do you feel we can really catch up with Russia, assuming that they are working hard, too, sir?

Admiral HAYWARD. Yes, sir; they are working hard.

Technically, I feel sure we can catch up with them. We are ahead in many basic fields.

Mr. KARTH. I mean in the missile field.

Admiral HAYWARD. I believe in the missile field, too.

Mr. KARTH. Hard work is your answer there?

Admiral HAYWARD. Yes; hard work is my answer to that, too.

Mr. KARTH. And this is brought about by letting the technical people in the missile field in our country, like yourself and Dr. York, make some of these decisions, rather than having them go upstairs to people who really don't have the technical know-how. Is this correct, sir?

Admiral HAYWARD. Well, that is a complex question. It goes all of the way back to the end of World War II.

Mr. KARTH. Yes; but I am trying to see how we can cut down this leadtime, because the Russians' leadtime is less than ours, and their know-how is just as great, or possibly—well, let's say just as great. I am wondering how we can catch up unless we give more authority to people like you to make the decisions.

Admiral HAYWARD. Well, if you just refer to the missile field, the curve is getting pretty flat now. I think that we will surpass them in the missile field. I am talking about the Navy's point of view—the Polaris system, I think this system is far superior to anything the Russians have today. It isn't in operation, no, but it will be, and in that period of time I feel that we will have beaten them in the missile field, but this isn't the end. This isn't just the objective. That is the point that I am trying to make. It goes deeper than that. And this struggle is going to exist for the rest of my life and the rest of your life, unfortunately.

So we have to work hard and to sacrifice to make sure that we keep our freedom.

Mr. KARTH. However, do you feel that cutting down on the leadtime will give us more security in the field that we are talking about today insofar as gaining and catching up more quickly with Russia?

Admiral HAYWARD. Oh, certainly.

Mr. KARTH. And you feel the way to cut down this leadtime is to provide greater appropriations in this field? Do you feel that this would reduce the leadtime, sir?

Admiral HAYWARD. Well, yes, sir. In my request for money I asked for $770 million, for instance, and I was given $522 million.

Mr. KARTH. I was just wondering whether this money could reduce the leadtime, which apparently today is just as long or longer than it is in Russia.

Your answer apparently is "yes."

Admiral HAYWARD. Yes.

Mr. MCCORMACK. Will the gentleman yield there?

Mr. KARTH. Yes, sir.

Mr. MCCORMACK. We have the brains, Admiral, haven't we?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. And we have the facilities?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. It is the question of leadership that will coordinate them into concentrated activity. That means a combination. Essentially, wouldn't it be quick and early decisions and then the money?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. The way to shorten your leadtime, or one of the ways, is to cut down this long period of time that is taken in connection with making the decision to go ahead or not go ahead.

Admiral HAYWARD. That is the answer to the Polaris program.

Mr. MCCORMACK. And once the decision is made, to follow up with the money?

Admiral HAYWARD. That is correct.

Mr. MCCORMACK. We then have to rely on you and other dedicated men. That is all we can do.

Admiral HAYWARD. That is correct.

Mr. KARTH. No further questions.

The CHAIRMAN. Mr. Hall.

Mr. HALL. Admiral, have you done any work on antimissile missiles?

Admiral HAYWARD. Yes, sir; and I am prepared in closed session to discuss what we have done on that, on the blackboard, when we have the closed session.

Hr. HALL. Is there anything you can say about it in open session?

Admiral HAYWARD. No, sir; except it is the Navy's responsibility to defend the continental United States against submarine-launched missiles. There is no sense in finding a submarine and telling somebody back here he has just launched a missile. You should do something about it right then. So that is our responsibility, and we looked at it from that point of view.

Mr. HALL. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Admiral, in answer to one of the questions put to you by Mr. Miller, you said, "I hope Dr. York has the stature to accomplish this." I think that is a direct quote.

Do you think that a program of this magnitude and importance should depend upon such a hope?

Admiral HAYWARD. I don't recall saying—I say that Dr. York has the stature to accomplish this technically, particularly with technical questions.

Mr. DADDARIO. Well, doesn't this really go back then to having some kind of program that does not depend upon men of stature being in the right place at the right time, but rather a program which can make more easy and more expeditious the accomplishment of these problems, so that when you do present a program, you don't have to go through such a myriad of people in order to get your final "yes," and then get down to work.

Admiral HAYWARD. Well, my feeling—emphasizing the man that we have at the technical level—unfortunately the people that come into Government in our country, primarily their background is law or fiscal. Very seldom are they technical. Now, he could be a very fine person but if he didn't have the technical background, he would be at the mercy of anybody who came in and sold him a technical program, so it has to depend on people, and we have to depend on getting good people into the Government of the type, as Dr. York.

Mr. DADDARIO. Well, I remember a lawyer from my State, Brien McMahon, who headed the Joint Atomic Energy Committee, and he seemed to realize these problems. Don't you think it goes back to what was said the other day, that we need something on the order of the AEC in order to accomplish in this field the same or greater accomplishments that were performed there?

Admiral HAYWARD. My testimony last year was along that line. Of course, Brien McMahon was an unusual person, and I give tremendous credit to this man for the atomic energy program we have today. He had vision and good technical vision, and he was a tremendous American. I join you in admiration for that man.

Mr. DADDARIO. We have a prototype really in the AEC and in the vision which the late Senator McMahon exemplified to again utilize that similar approach to this problem, which is before us today. It worked there, and that was a complex problem. It can work here, can it not?

Admiral HAYWARD. Yes, sir. Of course Congress went into this, I am sure, as the chairman pointed out last week. A lot of us testified along this line last year, before Mr. McCormack on it.

Mr. DADDARIO. Thank you, Admiral.

The CHAIRMAN. Mr. King.

Mr. KING. Admiral, there was recently a feature article in the Saturday Evening Post written by an American scientist, and I believe his name was Cohn or Cohen, who had toured Russia. His conclusion was that in almost every field of scientific endeavor, with the possible exception of chemistry, the Russians were either ahead or they had developed a momentum, a pace, that assured them that they would be ahead within the foreseeable future. That was the thing that alarmed him so much, the accelerated pace, the tremendous impetus that they had given in the fields in which we were admittedly ahead at the present time.

Well now, my question is this: Do you feel that the pace, the momentum, that the Russians have set in this satellite field right now is greatly ahead of ours, even in those areas in which we perhaps are technically ahead of them, so that actually they will remain ahead of us or overtake us unless we can accelerate our pace, which we have not done?

Would you want to discuss that?

Admiral HAYWARD. Well, they are ahead in the rocket engines, but from their instrumentation I am not so sure that I buy his statements, because they took our spectograph right out of the Vanguard and put it in their Sputnik III and had no hesitation to do it. They didn't have anything of this nature. There are a lot of other fields where I don't think they are ahead. However, I agree the momentum is tremendous in the scientific and technical fields in Russia. They have made the statement that they are going to beat us technically, and they are really putting tremendous effort into it, along this line, but I feel they have a tremendous way to go yet, and we have to get working and working real hard.

Mr. KING. This Dr. Cohen pointed out that they could draw on such a vaster potential of incoming scientists. He gave a lot of figures. I don't remember them. But in engineers it was 3 to 1 over us, and in other fields it was comparable to that, He said their ability to draw on this great potential of incoming scientists, plus the fact that they were given better consideration in budgetary matters, and the fact that their scientists were made the heroes of Russia instead of the athletes and the movie actors, and so on, that all of that gave an impetus to this thing that just seemed to be carrying them forward a lot faster than we were able to accomplish here.

Admiral HAYWARD. Well, essentially he is correct. If you look at the scientists who have won prizes from our Government, you can count them on one hand. Dr. MacLean, Enrico Fermi, Lawrence. Over there you will get people such as the other Mikoyan, Gurovich, who will have won four or five Lenin prizes, which are equivalent to about $35,000 apiece, tax free. They are the heroes of the Soviet Union. Of course they work under this dual system. If they are not the heroes and they don't do their job, they are liable to get shot or sent to Siberia, which gives them a great incentive, but they have a completely controlled setup this way, and they have rewarded their scientists very well.

Mr. KING. It seems to be paying off in their case rather dramatically, doesn't it?

Admiral HAYWARD. Yes, it does.

Mr. KING. That is all.

The CHAIRMAN. Admiral, let me ask you this: You say they took a part of the Vanguard out and used it in Sputnik III?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. How did they get ahold of that part?

Admiral HAYWARD. The whole design of the Vanguard was an unclassified project, you remember, and they knew everything we were doing in the I.G.Y. This was perfectly open information, not classified information. It was strictly scientific.

The CHAIRMAN. Did we give them all of the machinery, all of the technical equipment and all that we had in the Vanguard?

Admiral HAYWARD. Sir, they have a tremendous advantage on us in that respect, Mr. Chairman. They spend roughly a billion dollars a year in getting every technical journal we put out into the Western World and translating it and when they start a project they have all of the advantages of everything they have read so they start where we left off.

The CHAIRMAN. You mean they spend a billion dollars on that?

Admiral HAYWARD. A year, yes.

The CHAIRMAN. What do we do in that connection?

Admiral HAYWARD. I do not know, but it is not that much. We have our National Science Foundation effort and other efforts that you will probably get into on the committee. But this is something they have done for years.

The CHAIRMAN. Do we give them all of the inner working and machinery of the other missiles, such as the Zeus?

Admiral HAYWARD. They subscribe to every technical magazine. What you read in Aviation Week they read. What you read in the American Physical and Chemical Society they read, they translate. I try to get as much of theirs as I can.

The CHAIRMAN. Did we give them the Redstone?

Admiral HAYWARD. Whatever is published in open magazines is available to them on subscription.

The CHAIRMAN. Other than that they get no information.

Admiral HAYWARD. No, sir.

The CHAIRMAN. But your point is it is all published.

Mr. ANFUSO. Mr. Chairman, will you yield to me?

The CHAIRMAN. I yield.

Mr. ANFUSO. The Russians have boasted that everything they do they publish and they have published scientific magazines of everything they do, and those scientific magazines are piling up in our libraries with nobody to translate them.

Admiral HAYWARD. The American Physical Socity of course has done work in this line and the National Science Foundation. It is a tremendous job. Technically we would like very much to be able to do this on machines if we could and we are putting some effort into trying to do this but another thing we are doing is we are teaching a lot of our children how to speak Russian, too, and to translate, but the effort should be increased in this field, of course.

Mr. ANFUSO. Is it true, Admiral, that most of the things they do are actually published in a Russian scientific magazine?

Mr. MCDONOUGH. And available to the rest of the world.

Mr. ANFUSO. Yes.

Admiral HAYWARD. Quite a bit of it is. I do not believe anything they say unless I have documents to prove it.

Mr. ANFUSO. Anyway you have seen many Russian magazines.

Admiral HAYWARD. Yes.

Mr. ANFUSO. Do we have the means of translating them and making that available to the people who should have the information?

Admiral HAYWARD. There are certain technical societies who do this. I know in my society, the American Physical Society, the translations on all of the high energy machines, the bevetrons, things of this kind that the Russians are doing. We translate all of those articles at places such as the University of California radiation laboratory where they are vitally interested in it.

Mr. ANFUSO. How about any of our branches of Government?

Admiral HAYWARD. Yes, sir; we have the National Science Foundation and the Congressional Library.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Roush.

Mr. ROUSH. Mr. Chairman. Admiral, as I have sat through these hearings the past couple of weeks, I get the impression that all of our questions are directed toward the thought that America feels we are behind Russia. Now today you stated that you thought our solution was perhaps a little more money for some of your projects, but mainly hard work. I sat in on a meeting not too long ago in which the question was asked of General Medaris of what can we do to catch up with Russia, other than provide funds, and he made this statement: If we could have a decision which would be irrevocable for 2 years we could catch Russia.

Do you experience any difficulties of that sort, Admiral?

Admiral HAYWARD. In getting decisions, yes, sir. However, on the systems on which we have gotten a decision, you see the Polaris system was one where the decision was made and it was implemented with funds, and that system will be the result of an early decision and an implementation. There is no question about it, Mr. Roush, if you have the decision and implementation, you can make progress.

Mr. ROUSH. Well, all of these "yes's" and "no's," though, they hinder that, do they not, this power to make a decision and stick with it and follow through until we have something concrete and real?

Admiral HAYWARD. Yes, sir. In connection with that, last year in the hearings before the Johnson committee, I recommended one of the best things you could do for research and development was to make the budgetary cycle 2 years. I will tell you exactly what happens just to show you.

I go through now the 1960 hearings. I get my money July 1. Then I justify it through the reapportionment procedures. Until I get it apportioned I do not really know what I have. I am already cranking through the next year's budget and I do not know what programs I will have this year. The fiscal processes instead of being comptrollers, they are controllers. This is what we have gotten ourselves into. A 2-year budget cycle for the research and development appropriation, which is what I recommended and my Assistant Secretary of the Navy, Mr. Norton, mentioned last year, would certainly help the process of the decisions General Medaris is talking about, because each year he goes back to rejustify his decision and they may change the decision.

That is what I think he was talking about.

Mr. ROUSH. Thank you. That is all, Mr. Chairman.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Well, outside of Government, Admiral, there is a lot of research and development in private industry that is of aid to our whole scheme of things here.

Admiral HAYWARD. That is tremendous; yes, sir.

Mr. MCDONOUGH. There are no budgetary requirements there, there are no congressional investigations and hearings, there is no line of command. They just go right ahead and develop. If they come up with something, they bring it to the Government as a proposal to put

into effect because they think it will work. Does it not come around that way? You have any number of reliable institutions in this country in private enterprise that are making proposals all the time to improve our missile and satellite program. Is that not true?

Admiral HAYWARD. That is true. Of course they have another fact or that is governed by their proposal, I have seen a lot of them, and that is the profit and loss statement. It is hard sometimes to—well, let me say industry goes about it in two ways with us. They will develop something proprietary and come and propose it or they will come with a proposal for a path to go down and they do a tremendous amount of work in American industry that is applicable to our program.

Mr. MILLER. Would the gentleman yield?

Mr. MCDONOUGH. I would just want to pursue another thought. You say profit and loss. That applies, of course, to the private institutions.

Admiral HAYWARD. That is right, they have to have an incentive.

Mr. MCDONOUGH. That does not altogether apply and there is not any reason for it to apply where the Government itself is attempting to arrive at a conclusion. But the profit and loss motive has no application at all in Russia, evidently.

Admiral HAYWARD. That is correct.

Mr. MCDONOUGH. So the reason they go ahead without regard to whether it is going to be profitable or otherwise is merely the decision of the heads of the Government that "we want this done, we do not care what it is going to cost;" probably they would not say it that way, but we want this accomplished, so if we are going to match our system against their's with the idea of exceeding them in those things that we may be behind, we have got to set the profit and loss feature aside and we have got to forget some of this complication of the line of command. The question in my mind is how much of that do we have to do and in what lines. I have never been convinced that we are not at least on a level with them in most of the scientific development in space and ICBM development. We are behind or probably a little behind on some of these things.

What this committee, I think, would like to know is in what avenues should we go without regard to profit and loss and without regard to military commands that encumber this operation. That is more of a statement than a question, Admiral.

Admiral HAYWARD. Yes, sir.

Mr. MCDONOUGH. Mr. Miller.

Mr. MILLER. I just wanted to say, we talk about private industry doing some of this stuff. Well, there is another phase, where you go to private industry, give them the guidelines and say, "we want you to develop this and we will pay for all this."

Admiral HAYWARD. That is right, and then we have the proprietary rights.

Mr. MILLER. And there is more of that than anything else; is there not?

Admiral HAYWARD. Yes.

Mr. MILLER. A great deal more.

Admiral HAYWARD. They are dependent on us for that.

Mr. MILLER. They are dependent on you for that, so that falls into the same category.

Mr. MCDONOUGH. In the broad advance on the scientific front, insofar at physics is concerned and metallurgy and biochemistry for space exploration, on the broad front, in your opinion, do you think we are behind Russia?

Admiral HAYWARD. No, sir; I do not.

Mr. MCDONOUGH. Then we are doing a lot of other things Russia is not doing, but they are concentrating on some particular objective and making a spectacular advance in certain places.

Admiral HAYWARD. They are doing real well in the psychological war.

Mr. MCDONOUGH. That is the point.

Mr. ANFUSO. Would you yield?

Mr. MCDONOUGH. Yes.

Mr. ANFUSO. There is a lot of talk about what private industry can do and I am a great believer that private industry can do a great deal. But when it comes to security and safeguarding our country, I believe that it requires an awful lot of initiative from Government itself. Is that not so?

Admiral HAYWARD. Yes. However, the private industry is awfully good.

Mr. ANFUSO. Private industry is always seeking to make a profit.

Admiral HAYWARD. Yes, but some of them have passed over profits for the good of our country.

Mr. MILLER. Once they have been given a project.

Admiral HAYWARD. I can show you concerns today that are putting their own money in the antisubmarine warfare business with no contract or anything else because they think the problem is important.

Mr. ANFUSO. Let me give you this example, Admiral. You remember Dr. Dornberger.

Admiral HAYWARD. Yes.

Mr. ANFUSO. Dr. Dornberger used to be connected with the German V–2 missiles.

Admiral HAYWARD. That is correct.

Mr. ANFUSO. In private industry he developed this Dyna Soar. Is that correct?

Mr. MCDONOUGH. He is developing it.

Admiral HAYWARD. It is a proposal, let me say. It is on paper.

Mr. ANFUSO. He had it in pretty good condition, I would say, and it took him 7 years to get the go-ahead sign. Is that not right?

Admiral HAYWARD. To get the hardware, as we say it.

Mr. ANFUSO. Yes.

Mr. MCDONOUGH. Mr. Chairman.

The CHAIRMAN. The Chair recognizes Mr. McDonough.

Mr. MCDONOUGH. As to this initiative on the Dyna Soar, if they proceeded faster than they should have and if on the Government level they spent a couple of million dollars they should not have and produced nothing, what is the result of that? These men in uniform are subject to this committee and the Congress and we call them in at the drop of a hat. There may be an error where a lot of money is spent and nothing results. They are dealing with your opinion and my

opinion and the opinion of the other Members in the House and Senate. That does not apply in Russia.

The CHAIRMAN. Any other questions? Mr. Ducander.

Mr. DUCANDER. No questions at this time.

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. Admiral, I see the across-the-board picture you give, but I would like to get your opinion as to the immediate problem that confronts us in connection with possible danger. We are told that our main retaliatory power is SAC. Do you agree with that?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. The general impression is that the Soviets are ahead of us in the field of intercontinental ballistic missiles. Do you agree with that, as of today?

Admiral HAYWARD. As of today, I think, in the rockets, we are behind.

Mr. MCCORMACK. And we are behind in the field of intercontinental ballistic missiles?

Admiral HAYWARD. I think in the guidance we are ahead and I think in the rocket engine itself we are behind, so guidance is on the top of the missile and the rocket engine makes it go.

Mr. MCCORMACK. Is it not fair to assume they are working, too, on guidance?

Admiral HAYWARD. Oh, yes, sir.

Mr. MCCORMACK. And overcoming the other difficulties in connection with the missile hitting its point of destination?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. Suppose they complete the intercontinental ballistic missile and make it a workable military instrument before we do and at the same time they devise a pretty good defense against our intercontinental bombers. Where are we?

Admiral HAYWARD. We are in trouble.

Mr. MCCORMACK. Serious trouble; are we not?

Admiral HAYWARD. We have to prevent that from happening.

Mr. MCCORMACK. That is true. And it is fair to assume they are considering a defense against our bombers; is it not?

Admiral HAYWARD. Oh, yes, sir.

Mr. MCCORMACK. Now, I want to refer to something that has not been gone into that has interested me for years. I sense that there is a pretty good spirit existing now between the men who wear the uniforms and the scientists.

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. Several years ago there were some conflicts; is that correct?

Admiral HAYWARD. Yes, sir.

Mr. MCCORMACK. And is my inference correct that that has improved?

Admiral HAYWARD. Speaking for the Navy, very definitely, of course. We have lived very closely with the scientists for a good many years.

Mr. MCCORMACK. Well, you are one yourself; is that correct.

Admiral HAYWARD. Yes.

Mr. McCormack. So while you wear the uniform of a rear admiral you are a scientist, just like a doctor is a doctor. He might wear the uniform, but he is a doctor.

Admiral Hayward. Yes, sir; I always call myself Physicist Third Class, Mr. McCormack.

Mr. McCormack. Now, what has been done in connection with building up within the Navy—and the same should apply to the other services, but you are here in your position and rank in the Navy—what has been done in the Navy to building up a specialized corps of young career officers starting out to devote their entire military or naval life to this highly specialized field? That involves also the opportunity of advancement, which is human, and so forth. What has been done in that direction, Admiral?

Admiral Hayward. We are really working on this. I can give you some concrete things we have done already. I feel very strongly that the officers of the future, your Chiefs of Staff and the top people, have got to be competent technically to make some of these horribly complex decisions. So we are looking for the time when all of our officers in the Navy will have had postgraduate training in some specialty.

Last year, for instance, we selected the top five at the Naval Academy to pick for graduate training right away, to put them through to get their doctorates. We are getting a great number of the people that we put into school shortly after World War II with their degrees and we are looking forward to the time when they will specialize all of the way up to commander, whether they are aviators or missile people, and when they got to that rank you would begin to give them the broad general education, because it is when they are young that they should really get the technical and the scientific training in their specialization. Mr. Jackson, who is our Assistant Secretary for Personnel, has taken a very active interest in that, and we are overhauling our whole program for the education of the officer corps of the Navy.

Now we have another group which are the boys that enlist in the Navy—I enlisted in the Navy, and when I was an enlisted man the only opportunity I had was to go to the Naval Academy, to get a university education. Now, however, we have a program where the people who mature late enlist in the service and get to be 22, 24, 25 even where they are married or whatever their status is, if they can qualify to go to a university we will send these enlisted men to universities. This program has been a marvelous success.

Incidentally, the No. 1 engineering student in Purdue University today is an electronic technician first class, 29 years old, who is married and has five children. When they graduate from this university, of course, they become officers. We are trying to make a broad frontal attack on the whole educational problem that faces your officer corps. They have to be professional really and they cannot just be technicians. As you know, there is a great difference between a technician and a professional, and we have to give them the opportunity of advancement to make it a really worthwhile career for them in the service of their country. I have great hope for it.

You know we are really proud in the Navy that the first American Nobel Prize winner in physics was a naval officer. Most people do not know this, but he was Michaelson who was the graduate of the class of 1876 from the Naval Academy and did the basic work in light

and it was his work with Max Planck that gave rise to Einstein's theory. So we in the Navy have a great deal of pride in our professional and technical qualification really, and we are going to see that we even do more of it, and my boss, Admiral Burke, is a very strong proponent of this. It is a problem and we should do just what you say.

Mr. MILLER. Would you yield?

Mr. MCCORMACK. I would be glad to.

Mr. MILLER. Admiral, would these men be officers of the line or will they be staff officers? Will their promotion come or will they have to have a running mate?

Admiral HAYWARD. My particular feeling, and as I say I am no personnel expert——

Mr. MILLER. Presently, what is it?

Admiral HAYWARD. Having come all of the way up from apprentice seaman, I think that they should be line, myself. I do not think that they have to be staff corps. I think that the great usefulness to the country and to the Navy is to know their specialty, but also to have the general background. You would not want to keep a technical man from being a Joint Chief of Staff or a chief of a service and if you do this across a broad front you will get this type of people. If you restrict it, I do not think you will.

Mr. MILLER. I want to say that I agree with you that they should be line officers. May I say for my colleagues who may not be familiar with this that in the Navy you have officers of the line and then you have staff officers. Staff officers are limited to certain fields as to what they can do and their promotion is determined by a line officer who enters the Navy about the same time they do. So, no matter how good they are, they cannot go up any faster than their running mate.

Mr. HALL. A satellite, so to speak.

Mr. MILLER. Yes, a satellite.

Admiral HAYWARD. Well, Mr. Miller, I think they should be line and, of course, you know I was captain of a ship. There was a time in Washington that I guess I was one of the few Democrats anyway because they made me captain of the *Franklin D. Roosevelt* and I felt that I was qualified to be captain of that ship even though I had technical training. The responsibility and authority that go along with the command of a big ship like that is a tremendous thing. It is the best job in the Navy. When you say "Go right" it goes right.

(Discussion off the record.)

The CHAIRMAN. Admiral, may I ask you a question? By the way, I will say this, I for one do not qualify you as only physicist third class, as you indicate there. I think you are doing a good job. I want to ask you in your narration of the advantages that the seaman in the Navy has. Did you put in the Holloway plan; did you include that?

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. Is that available to the seaman himself?

Admiral HAYWARD. Yes, sir; if he can qualify. The difficulty with a lot of the young boys that go into the service, they go as I did. I was not going to go to school, but they have not had the background in their high school to qualify to enter into a university. In our case with the enlisted men, the people that you get in that age bracket all of a sudden realize if they do not get an education they cannot go any

place. They are really highly motivated and we will help them in our prep school to really be ready to take on the university.

The CHAIRMAN. You can send them under the Holloway plan to a university if they are capable.

Admiral HAYWARD. Yes, sir; if they can qualify they can go.

Now, of course, the age brackets and the marital status are different in that plan than they would be in the straight enlisted man's plan.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I believe we should go back and take a look for a minute at the size of the budgets between our two countries. For example, you have said that on the space and missile program for the fiscal year 1960 it was proposed to spend $6.7 billion. On the recently announced Russian program for their overall scientific program, their currently announced budget is 71 billion rubles, which is about $18 billion in our money in the current calendar year. Of course, that includes both private and public and all of the effort toward science.

Could you estimate for us the rate of spending that we are doing in the space and missile field compared to that of Russia and also the overall effort that we in this country are putting on science? Is our budget for science big enough, overall, compared to the Russian $18 billion budget for this current year?

Admiral HAYWARD. Well, Mr. Fulton, I do not believe their figures, because they really are meaningless. They have such control. The Russian scientists have told my friends who have been there that there is no such thing as worrying about the budget. If they are going to go ahead with a program, money is just made available to them. Now, how they arrive at those figures I do not know, and I would not put too much faith in the actual figures.

Mr. FULTON. So you do not believe then that we can put any credence on whether we are ahead or they are ahead or the effort either country is putting into it by the budgetary figures alone.

Admiral HAYWARD. No, sir; I would not believe the budgetary figures. I feel their effort is a tremendous one, but to try to equate it to our dollar effort would be most difficult.

Mr. FULTON. There is one thing that has caused me some trouble from the previous testimony and I wish the Navy would check with the Office of the Attorney General. I have done some work on this space law with our counsel and others on the committee. To me there are no over-fly rights whatever for anybody in the satellite or the high-missile field. So, in our Pacific missile program, if we are going to deal with a nearby ranch on over-fly rights on polar satellites that over-fly the earth, I think we are getting into real difficulty.

It has been our policy with regard to space that it is akin to the freedom of the seas. No country has the right to block us and no country has any sovereignty over it, nor does any individual living within the country have an effective property right. So, I think you are following the wrong course. I do not think the Federal Government should have to pay over-fly rights to any individual within this country, to any citizen in a foreign country, or to any foreign country.

Admiral HAYWARD. Well, when a booster goes you do not want to kill a man or his cattle. It is a little more than the over-fly rights. As it goes over there if a booster falls off——

Mr. FULTON. Now you are talking tort law, but you are not talking contract law of taking a property right when you deal with him to negotiate for over-fly.

Admiral HAYWARD. The best solution to that, Mr. Fulton, would be to buy that land.

Mr. FULTON. I would be glad to do it, but I do not want the Government setting the policy of buying over-fly rights from anybody for a polar missile range.

Admiral HAYWARD. We will make sure we do not.

The CHAIRMAN. We already pay for over-fly rights. We do it around airports frequently. Is that not correct? We have been doing it for years.

Admiral HAYWARD. For air rights, Mr. Chairman, you are correct, and this is in the atmosphere.

The CHAIRMAN. And this is in the atmosphere leading up to a base, so the principle is the same as that which we have already been doing for years. Is that not right?

Admiral HAYWARD. That is right, yes, sir. It is going to be dangerous for those cows, Mr. Chairman.

The CHAIRMAN. I remember when we authorized it. Now, are there any further questions?

If not, we will go into executive session. There are some things we want to take up in executive session.

(Whereupon, at 12:02 p.m., the committee went into executive session.)

EXECUTIVE SECTION

The committee met in executive session at 12:05 p.m., in room 356, Old House Office Building, Washington, D.C., Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. Before I came in this morning, Admiral, a request was made for you to be here, sir, and you have some things you want to show us in executive session.

Admiral HAYWARD. Well, they wanted some questions answered, Mr. Chairman.

The CHAIRMAN. The admiral is prepared to answer any questions.

Admiral HAYWARD. I don't know whether the committee wants to finish up this morning. I have two space projects I was going to show them plus a discussion on the question Mr. Fulton asked me about the moon relay station * * *

The CHAIRMAN. I would suggest this, that you show us whatever you have first, and then we will have the questions.

Admiral HAYWARD. Commander Peters will give a presentation on a navigation satellite. This is a program designed to use space better for our tasks and missions. Of course navigation is one of them. * * *

Commander Peters is the program manager from the Bureau of Ordnance.

Go ahead, Commander Peters.

STATEMENT OF COMDR. IRVIN G. PETERS, PROGRAM MANAGER, NAVIGATION SATELLITE, BUREAU OF ORDNANCE, DEPARTMENT OF THE NAVY

Commander PETERS. Mr. Chairman, gentlemen, as the admiral has said, the unclassified code name for this project is * * *, and the * * *

Before getting into the principle, however, I would like to go into the history of this project briefly.

During the time that the first satellites were launched there were various methods used for tracking them. One method utilized angular tracking, another method used telescopic cameras which could record the motion as the satellite passed through the skies, and a third method used the Doppler system. * * *

This reverse process consisted simply of this: * * *

This proposal by the Applied Physics Laboratory was brought to the Navy. The Navy considered it in the Bureau of Ordnance and in Admiral Hayward's Office, and we in turn wrote to ARPA and expressed a desire to proceed with this subject.

ARPA, in turn, reviewed the proposal. It appeared to be sound to them, and they agreed to finance the project through at least the feasibility stage. * * *

I would like to discuss for a moment what the principle of operation is. * * *

The CHAIRMAN. Well, let me ask you this:

The Weather Bureau is using the same principle. * * * system, for testing storms. How does that work with them?

Commander PETERS. For testing what, sir?

The CHAIRMAN. Storms.

Commander PETERS. * * *

The CHAIRMAN. The difference in the sound of the storm, then?

Commander PETERS. Yes, sir. * * *

Mr. MCDONOUGH. Just a question there. * * *

Commander PETERS. Exactly the same; yes, sir. * * *

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. How far would this navigational satellite be projected into outer space?

Commander PETERS. I will get into that in a little bit. But to answer the question now, the satellite is designed for a circular orbit 400 miles above the earth.

Mr. MCCORMACK. How many of them would you have up at one time?

Commander PETERS. * * *

Mr. MCCORMACK. How long would they remain up?

Commander PETERS. They would have, as we anticipate now, a 5-year life. They would use solar batteries, and the solar batteries are adequate for the low-power output.

Mr. MCCORMACK. * * *

Commander PETERS. When I say "our position," I mean the exact position of any ship or aircraft, or it could even be a ground station.

Mr. MCCORMACK. Would that also mean in case of war an enemy?

Commanders PETERS. * * *

Mr. McCormack. From a military angle, of what significance would that be to us?

Commander Peters. * * *

Mr. McCormack. That is what I asked. * * *

Commander Peters. Yes, sir.

Mr. McCormack. * * *

Commander Peters. Yes, sir.

Mr. McCormack. That is why I asked the question.

Mr. Sisk. Mr. Chairman, could I ask a question? * * *

Commander Peters. I will not say that in the way that you have put it.

Mr. Sisk. * * *

Commander Peters. Yes, sir.

Mr. Sisk. * * *

Commander Peters. This system will give you a refinement on positions throughout the world, * * *

Mr. McCormack. In other words, * * *.

Commander Peters. Yes, sir.

Mr. Sisk. Well, if I might pursue, then, a little further, I understood when you started in on this * * * it would be a navigational aid.

Commander Peters. Yes, sir.

Mr. Sisk. That is, it enables ships, planes, or any other moving item to pin its position, worldwide?

Commander Peters. Yes, sir.

Mr. Sisk. * * *.

Admiral Hayward. * * *.

Mr. Sisk. Well, that is fine, then, Admiral. That gives me the explanation I was seeking. This is primarily to pin your position.

Admiral Hayward. Yes.

The Chairman. Mr. Quigley.

Mr. Quigley. Admiral, this is basically a navigation aid and not a fire control?

Admiral Hayward. That is correct.

The Chairman. Let me see if I understand you correctly now. That will assist you in making more accurate maps of the whole world?

Admiral Hayward. That is right, yes, sir.

The Chairman. Now, if you had a case like we had last week of that ship off the coast of Greenland, sinking there, you would not have to send ships up and down the sealanes to locate that, but you could pinpoint that * * *.

Admiral Hayward. If the Norwegian had the system and had sent, he could have sent us an accurate position and we would have known where to go.

The Chairman. Immediately.

Admiral Hayward. Yes, immediately.

But it was a stormy day and everything else. He doesn't have a sight——

The Chairman. If that were a Russian submarine instead of a boat sinking, what about that? Would you be able to locate that submarine * * *.

Admiral Hayward. No, sir. This is a straight navigational system.

The CHAIRMAN. And it depends upon some action from the target there?

Admiral HAYWARD. Yes, sir. In other words, if you have your earth systems today, your hyperbolic systems like loran, this is just another navigational system. However, it is a more accurate system * * *.

But this is a system where it could help us in the Navy tremendously, and actually the cost of it when you begin to think of people out on various stations where they have to put them, it may be considerably cheaper.

The CHAIRMAN. * * *.

Admiral HAYWARD. That is right. However, we will show you we have another system for just what you gentlemen are talking about.

Mr. MCDONOUGH. Just one question at this point. * * *

Commander PETERS. * * *

Mr. MCDONOUGH. Now, do I understand you send a signal from the earth to the satellite and then that in turn——

Commander PETERS. * * *

I will go into some of the ideas along this line.

Mr. MCDONOUGH. Describe those various curves. * * *

Commander PETERS. No, sir, I will describe these now. * * *

What this might amount to in a sense is saying this: * * *

Mr. MCDONOUGH. Now, as I understand it, this is a scheme that is under consideration but not now in operation?

Admiral HAYWARD. That is correct. It was proposed. ARPA is funding it up to feasibility stage, and as I have pointed out, ARPA is the part of the Department of Defense that has money for space projects in the Department of Defense.

Mr. MCDONOUGH. This is a principle in physics, isn't it?

Admiral HAYWARD. Yes, sir.

Mr. MCDONOUGH. And it is known to the Russians or are they using such a system?

Admiral HAYWARD. It is known to them, yes. * * *

The CHAIRMAN. Proceed, sir.

Commander PETERS. There is one question which might have occurred to some of you. * * *

The CHAIRMAN. When do you think that is going to be?

Commander PETERS. * * *

The CHAIRMAN. What is that system going to cost us?

Commander PETERS. * * *

The CHAIRMAN. * * *

Commander PETERS. * * *

The CHAIRMAN. * * *

Commander PETERS. Yes, sir.

The CHAIRMAN. You will be able to reach any part of the world?

Commander PETERS. * * *

The CHAIRMAN. Would that system be available to other peoples as well as to the United States?

Commander PETERS. * * *

The CHAIRMAN. * * *

Commander PETERS. * * *

Mr. QUIGLEY. Mr. Chairman.

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Does the Navy visualize that this will be so accurate that they would only need to take * * *

Commander PETERS. * * *

Mr. QUIGLEY. Now, one other question: * * *

Commander PETERS. * * *

Mr. QUIGLEY. * * *

Commander PETERS. Yes, sir.

Mr. QUIGLEY. And the ship or the plane is just using its instruments to determine its relative position at any given time?

Commander PETERS. Yes, sir.

Mr. QUIGLEY. * * *

Commander PETERS. Yes, sir.

Mr. QUIGLEY. * * *

Commander PETERS. Yes, sir.

Admiral HAYWARD. * * *

The CHAIRMAN. I think it might be an excellent idea, Admiral.

My plan now is to adjourn somewhere around 1 o'clock. I don't believe we are going to be able to complete this today, but we can complete the hearing next Thursday.

Admiral HAYWARD. All right, sir. I would like to save Polaris until next Thursday, * * *

The CHAIRMAN. Go ahead.

(The top secret presentation was not made a part of the written record.)

The CHAIRMAN. Gentlemen, it is 5 after 1. The staff is in this shape: They are going to be pretty busy getting ready to leave tomorrow, and my thought is this: We have set up a program for Monday. I think it is weather. ARPA is Tuesday and Wednesday. Now, we can continue this Thursday, if that would be all right.

Admiral HAYWARD. Yes, sir.

The CHAIRMAN. It would seem to me, at this late hour, rather than go into questions, it would be better to do that.

So, if there is no objection, the committee will adjourn until Monday morning at 10 o'clock.

(Whereupon, at 1:09 p.m., the committee adjourned, to reconvene Monday, February 16, 1959, at 10 a.m., on another subject.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Tuesday, February 17, 1959.

The committee met at 10 a.m., in the caucus room, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order. Mr. Ducander, will you tabulate the roll as the members come in. It has been our policy always to keep a record of those in attendance but to give everybody time to get in before calling the roll.

This morning we have what I think is an historic session. We have as witnesses Dr. Herbert F. York, Director of Defense Research and Engineering, of the Department of Defense, Mr. Roy Johnson, Director of ARPA, and Mr. William M. Holaday, Director of the Office of Guided Missiles, Department of Defense, Chairman of the Civilian-Military Liaison Committee, NASA. All of these witnesses are in, I should say, critical positions. They are in positions of authority which can be especially helpful to our program, so I am glad that we have all of them here this morning.

Now all of them have prepared statements. I have read these prepared statements. We have sent copies to all of the members of the committee yesterday and my thought is that this morning we would proceed first to let them all present their prepared statements. One statement complements the other statement and after letting them all proceed with their prepared statement, we can then ask them questions on their own statement or any other statement presented this morning. If there is no objection to that procedure, we will do that.

We will ask Dr. York as the first witness to proceed with his prepared statement.

STATEMENT OF DR. HERBERT F. YORK, DIRECTOR, DEFENSE RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE

Dr. YORK. Mr. Chairman and members of the committee; I welcome this opportunity to appear before you and to present a brief statement concerning the new Office of Director of Defense Research and Engineering. I want to say at the outset that it is highly gratifying to note that this committee is not only deeply concerned with how we are doing in our space programs but is equally concerned with the advancement of science on all fronts. In my new job I find that the Department of Defense is indeed involved in science and engineering across the board.

Since Mr. Holaday and Mr. Johnson are also here this morning and will follow me, I will not go into any detail with respect to the programs of their respective offices. However, I do want to present an

explanation of the authority and responsibility of my office and its relationship to other DOD agencies.

The basic concept of the new position of Director of Defense Research and Engineering was set forth by the President in his message to the Congress that accompanied his defense reorganization proposal of last year. He said that the new position would replace that of the Assistant Secretary of Defense, Research and Engineering, that the Director would rank immediately after the service Secretaries, and that he would have three principal functions: (1) be the principal adviser to the Secretary of Defense on scientific and technical matters; (2) supervise all research and engineering activities in the Department of Defense, including those of the Advanced Research Projects Agency and of the Office of the Director of Guided Missiles; and (3) direct research and engineering activities that require centralized management.

I believe the relationship of my Office to other Department of Defense agencies is best understood when viewed in the following context. There are four basic operating agencies in the Department of Defense—Army, Navy, Air Force, and the Advanced Research Projects Agency. These agencies all do research and engineering either "in house" or by contract with outside sources. The function of my Office is to supervise and coordinate all research and engineering regardless of what agency undertakes the task or the nature of the task undertaken.

A fuller explanation of the relationship of my Office and the Advanced Research Projects Agency and the Office of the Director of Guided Missiles was made by Secretary McElroy before the House Armed Services Committee earlier this month. He said that—

> the Director of Defense Research and Engineering will supervise and coordinate all Department of Defense research and engineering programs. He will be responsible for providing effective leadership, eliminating unnecessary duplication, encouraging basic research, and developing an integrated research and development program covering all operational needs.
>
> We plan to continue the Advanced Research Projects Agency. It will be an operating Agency paralleling the research and engineering organizations of the military departments. The Director of this Agency will report to me administratively. However, his research programs will be subject to the supervision and coordination of Dr. York's Office just as are those of the military departments.
>
> Mr. Holaday's job as Director of Guided Missiles has had two quite different aspects. One has been to monitor and supervise all research and engineering work in the field of guided missiles; the other has been to assure appropriate priority handling of all guided missile problems in connection with their transition from the research, engineering, and testing stage into production and procurement. The research and engineering responsibilities of the Director of Guided Missiles together with the personnel involved will be transferred shortly to the Director of Defense Research and Engineering.
>
> I might interpolate some of them are being transferred, I believe, today. We will proceed with deliberate caution with respect to the priority and production responsibilities in order not to lose any of the momentum the program has developed. Therefore, for a time at least, Mr. Holaday will remain as a Special Assistant to me with the assignment to continue to handle those special aspects of the program which are beyond the research, engineering, and testing phase.

Further, I have made available to you and your staff a DOD directive issued by Secretary McElroy on February 10 which spells out my authority and responsibility. I call your particular attention to page 4, section V. A 2, Authorities, which reads:

> Approve, modify, or disapprove programs and projects of the military departments and other Department of Defense agencies in his assigned fields to eliminate unpromising or unnecessarily duplicative programs, and initiate or support promising ones for research and development.

I believe this section is self-explanatory and should remove any confusion as to my authority. However, I don't intend to use this authority as a club but rather, I expect to function as a staff officer to the Secretary of Defense and to develop the very closest and harmonious working relationship with the military departments. Because of my close past association with Mr. Holaday and Mr. Johnson, there already exists this harmonious working relationship. It is fair to say that an excellent start has also been made with the people in the military departments in developing what I believe is the necessary rapport for effective results.

Next, I would like to cover the current funding situation as it applies to DOD programs for research, development, test, and evaluation. For a number of years the research and engineering appropriations have not included all of the funds which support the program. Construction at research and engineering establishments has been paid from military construction appropriations, major procurement costs for test and evaluation have been paid from procurement and production appropriations, and military personnel costs for such personnel engaged in research and development work have been paid from military personnel appropriations.

This year the budget structure has been realined to include a considerable amount of the test and evaluation procurement in the research and engineering appropriations. The related construction and military personnel costs remain in the separate appropriations. However, my office takes a very active part in the review and final determination of the amounts that will be included for these purposes, specifically in the military construction area. In the fiscal year 1960 military construction program, for example, there were more than 180 R. & D. type facility items totaling close to $200 million that were considered in the review that was accomplished as a joint effort between my office and the Office of the Assistant Secretary of Defense, Properties and Installations. The expanded research and engineering appropriations, which have been labeled "Research, Development, Test, and Evaluation" in the fiscal year 1960 budget, now total $3.772 billion. It is difficult to determine the comparable figures for previous years, but there are estimated to be $2.258 billion in fiscal year 1958 and $3.464 billion in fiscal year 1959. In addition to these funds, there are items separately identified as supporting research and development but still remaining in the procurement appropriations. This total support from all appropriations has increased considerably in recent years primarily because of the very expensive weapons systems included.

The new obligational authority, planned obligations, and planned expenditures for fiscal years 1958, 1959, and 1960 are as follows:

[In millions of dollars]

	New obligational authority	Obligations	Expenditures
Fiscal year 1958	2,258	2,503	2,034
Fiscal year 1959	3,464	3,522	3,020
Fiscal year 1960	3,772	3,722	3,384

Within the new research, development, test, and evaluation appropriation there are eight major activity classifications. Excluding the emergency fund of $150 million, these categories and the fiscal year 1960 funds requested for each are—

Military sciences, $364.1 million;

Aircraft and related equipment, $497.3 million;

Missiles and related equipment, $1,410.8 million;

Military astronautics and related equipment, $309.1 million;

Ships and small craft and related equipment, $161.6 million;

Ordnance, combat vehicles and related equipment, $229.0 million;

Other equipment, $441.0 million;

Programwide management and support, $209.3 million.

This adds to a very considerable program of research and engineering for military purposes with enough diversification and depth to meet with force the demands of rapidly changing world conditions. A nonaggressive nation never knows where it may have to fight, since it cannot choose the time nor place of attack. If the future follows the pattern of the past, there may be more limited wars along with the ever-present threat of massive attack. For these reasons we must be prepared for any type of enemy action wherever it may occur. We feel that the program as presently conceived provides the proper balance at this time. Should conditions change substantially, as may be expected in a program as dynamic as research and engineering, we will make appropriate changes and recommendations to assure the Congress and the American people that our military research and engineering programs will fully support present and future operational needs.

This concludes my prepared statement. I shall be pleased to attempt to answer any questions that you may have.

The CHAIRMAN. Thank you, Doctor. At this point it has been suggested that we place in the record a copy of the original directive of February 10, 1959, from the Department of Defense to which Dr. York has referred. If there is no objection, we will ask that the entire directive be placed at this point in the record.

(The document referred to is as follows:)

February 10, 1959
Number 5129.1
AdmAsst., S/D

DEPARTMENT OF DEFENSE DIRECTIVE

Subject: Director of Defense Research and Engineering

I. GENERAL

Pursuant to the authority vested in the Secretary of Defense and the provisions of the National Security Act of 1947, as amended, including the Department of

Defense Reorganization Act of 1958, the Director of Defense Research and Engineering shall have responsibilities, functions, and authorities as prescribed herein.

II. RESPONSIBILITIES

The Director of Defense Research and Engineering is the principal adviser and staff assistant to the Secretary of Defense in the following functional fields:

1. Scientific and technical matters
2. Basic and applied research
3. Research, development, test, and evaluation of weapons, weapons systems, and Defense materiel
4. Design and engineering for suitability, producibility, reliability, maintainability, and materials conservation.

III. FUNCTIONS

Under the direction, authority, and control of the Secretary of Defense, the Director of Defense Research and Engineering shall supervise all research and engineering activities in the Department of Defense and shall perform the following functions in his assigned fields of responsibility:

1. Recommend policies and guidance governing Department of Defense planning and program development.

2. Plan and recommend an optimum integrated program of research and development to meet the requirements of national military objectives and initiate projects to fill important gaps which may exist.

3. Review projects, programs, and objectives of programs of the military departments and other Department of Defense research and development agencies.

4. Develop systems and standards for the administration and management of approved plans and programs.

5. Evaluate the administration and management of approved policies, programs, and projects.

6. Recommend the assignment or reassignment of research and engineering responsibility for the development of new weapons or weapons systems, giving due consideration to the departmental functions set forth in DOD Directive 5100.1.

7. Direct and control (including their assignment or reassignment) research and engineering activities that the Secretary of Defense deems to require centralized management.

8. As approved by proper authority, engage in or designate appropriate research and development facilities to engage in basic and applied research projects essential to the responsibilities of the Department of Defense which pertain to weapons systems an other military requirements: (1) by contract with private business entities, educational or research institutions or other agencies of government, (2) through one or more of the military departments, or (3) by utilizing employees and consultants of the Department of Defense.

9. Recommend appropriate steps (including the transfer, reassignment, abolition, and consolidation of functions) which will provide in the Department of Defense for more effective, efficient, and economical administration and operation, will eliminate unnecessary duplication, or will contribute to improved military preparedness.

10. Recommend to the Secretary of Defense appropriate funding for research, development, test and evaluation, including allocations from the Emergency Fund, Department of Defense.

11. Keep the Department of Defense informed on significant trends in scientific research relating to national security and recommend measures to assure continuing progress.

12. Exercise administrative direction of the Weapons Systems Evaluation Group and assure its responsiveness to the needs of the Joint Chiefs of Staff and the Office of the Secretary of Defense for operations analysis.

13. In coordination with the Assistant Secretary of Defense (International Security Affairs), engage in programs for assistance to friendly countries in

military research and development and in the interchange of related scientific and technical information.

14. Such other duties as the Secretary of Defense assigns.

IV. RELATIONSHIPS

A. In the performance of his functions, the Director of Defense Research and Engineering shall—

1. Coordinate actions as appropriate, with the military departments and other Department of Defense agencies having collateral or related functions in the field of his assigned responsibility.

2. Maintain active liaison for the exchange of information and advice with the military departments and other Department of Defense agencies.

3. Consult with the Joint Chiefs of Staff on the interaction of research and development and strategy.

4. Seek formal statements of military operational requirements from the military departments or the Joint Chiefs of Staff, as appropriate, for research and development projects and equipment areas which appear to require such statements.

5. Maintain or arrange for the maintenance of active liaison with appropriate research and development agencies outside the Department of Defense, including private business entities, educational or research institutions or other agencies of government.

6. Make full use of established facilities in the Office of the Secretary of Defense, military departments and other Department of Defense agencies rather than unnecessarily duplicating such facilities.

B. The Secretaries of the military departments, their civilian assistants, and the military personnel in such departments shall fully cooperate with the Director of Defense Research and Engineering and his staff in a continuous effort to achieve efficient administration of the Department of Defense and to carry out effectively the direction, authority and control of the Secretary of Defense.

V. AUTHORITIES

A. The Director of Defense Research and Engineering, in the course of exercising full staff functions in his assigned fields, including those enumerated in Section III above, is hereby specifically delegated authority to—

1. Issue instructions and one-time directive-type memoranda, in writing, appropriate to carrying out policies approved by the Secretary of Defense for his assigned fields of responsibilities in accordance with DOD Directive 5025.1. Such instructions and memoranda to the military departments will be isued through the Secretaries of those departments or their designees.

2. Approve, modify or disapprove programs and projects of the military departments and other Department of Defense agencies in his assigned fields to eliminate unpromising or unnecessarily duplicative programs, and initiate or support promising ones for research and development.

3. Obtain such reports and information (in accordance with provisions of DOD Directives 7700.1 and 5158.1) and assistance from the military departments and other Department of Defense agencies as may be necessary to the performance of his assigned functions.

B. Other authorities specifically delegated by the Secretary of Defense to the Director of Defense Research and Engineering in other directives will be referenced in an inclosure to this directive.

VI. ABOLITION AND TRANSFER

A. The position of Assistant Secretary of Defense (Research and Engineering) is hereby abolished and all personnel, functions (including the administrative direction of the Weapons Systems Evaluation Group) and records of the Office of the Assistant Secretary of Defense (Research and Engineering) are transferred to the Office of the Director of Defense Research and Engineering as of the effective date of this directive.

B. All directives, instructions, memoranda, delegations of authority, or other issuance not canceled by this directive containing the title of Assistant Secretary of Defense (Research and Engineering) are hereby changed to Director of Defense Research and Engineering.

VII. CANCELLATION

DOD Directive 5129.1, dated March 18, 1957, is hereby canceled.

VIII. EFFECTIVE DATE

This directive is effective upon publication.

NEIL MCELROY,
Secretary of Defense.

Inclosure—1.

Feb. 10, 1959
5129.1 (Incl. 1)

REFERENCE TO OTHER AUTHORITIES SPECIFICALLY DELEGATED BY THE SECRETARY OF DEFENSE RESEARCH AND ENGINEERING IN OTHER DIRECTIVES

1. Authority to act for the Secretary of Defense in matters pursuant to Executive Order 9913, pertaining to the termination of OSRD as contained in DOD Directive 5128.6, dated 9 August 1954.

The CHAIRMAN. Next we have the statement of Mr. Johnson or Mr. Holaday. Who prefers to come next? Mr. Roy Johnson, Director of ARPA. There are three chairs there, gentlemen, and you may sit up here and hear what is said, and then you will be able to answer the questions more readily.

Mr. Roy Johnson, Director, Advanced Research Projects Agency, ARPA. Mr. Johnson.

STATEMENT OF ROY W. JOHNSON, DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY, DEPARTMENT OF DEFENSE

Mr. JOHNSON. I welcome this opportunity to appear before you to discuss the U.S. military space program, a program for which I have been assigned responsibility. We must have a strong and versatile military space program to insure that the United States achieves and maintains a superior capability to operate in space in defense of the Nation and the free world.

This is true simply because of the totality of the threat. Our security problem is not similar to that of the potential aggressor insofar as military space systems are concerned. The aggressor does not have to resort to complicated and expensive space activities to achieve early warning against surprise attack. We must have that alarm bell. The aggressor does not require the diversified strategic retaliatory posture as a deterrent to general war that we must have.

The Advanced Research Projects Agency has mobilized the great capability of the Department of Defense under the discipline, priority, and long-range planning necessary to provide the breakthroughs of space leadership. On the day ARPA was created, February 7 of last year, we began to study ideas and proposals to provide, not a fractional, but an order of magnitude propulsion jump. On August 15, 1958, ARPA issued instructions initiating the development of a 1½-million-thrust booster, utilizing clustered ballistic-missile-type engines. This booster is to be flight tested in the fall of 1960, which is about 2 years after initiation of the program. The clustered booster principle gained more than 3 years over other approaches to obtain this thrust level and at about half of the cost. The program is being pursued vigorously at the present time.

On August 29, 1958, ARPA initiated a program to develop a new high-energy, upper stage which will have utility in this and other programs. This high-energy, upper stage is to be available in time to be mated with the 1½-million-pound-thrust cluster. These two developments will provide the new building blocks necessary to place 35,000 pounds of useful payload into a nominal 300-nautical-mile orbit. This is the kind of weight launch capability that I think the United States has to have within the next 2 or 3 years.

In addition, as part of the long-range propulsion plan, on April 17, 1958, ARPA requested the Air Force to proceed with the development of a million-pound-thrust, single-chamber engine. ARPA considered that this engine would be available for use within about 5 years. ARPA presently views this basic building block, which is now under the auspices of the NASA, as our means for attaining thrust range of between 6 to 12 million pounds by clustering. Such a basic booster, with appropriate upper stages, will allow us to place between 200,000 and 400,000 pounds into a nominal 300-nautical-mile orbit or will give us the necessary propulsion to operate maneuverable space vehicles in defense of the free world.

Thus, the NASA and ARPA now have under development two great propulsion jumps. The first is from our Atlas booster capability of 350,000 pounds of thrust to a capability of 1½ million pounds of thrust.

The second propulsion jump is from the 1½-million-pound-thrust capability to a 6- to 12-million-pound-thrust capability.

This is the propulsion side of the story. We must also learn how to so guide and control a manned space vehicle that it can maneuver on an extended basis throughout vast regions of outer space in protection of an earth which will be growing as small as to become indefensible without such versatile vehicles.

This involves considerable knowledge we do not now have. However, were we not to plan for such eventualities, we should be considered ostrich-like.

As a beginning, we are now initiating the Discoverer program to learn how to return a satellite from orbit. Space satellite launches under the discoverer program are now in final preparation. The launch vehicle utilizes a modified Thor as the first stage and a new rocket called the Bell-Hustler as the second stage. This combination can launch satellites weighing approximately 1,300 pounds, including the weight of the second-stage vehicle, which will orbit as an integral part of the satellite. The initial launching primarily will be to test the vehicle itself, especially its propulsion and guidance. Later the satellite will contain biomedical experiments to seek data on environmental conditions, and recovery of these experiments will be undertaken. Both through this Discoverer project and by direct means, we are supporting the NASA project Mercury for development of manned recoverable space vehicles.

Beyond these programs, the Department of Defense is pursuing actively what we call "Mrs. V," our short name for a truly maneuverable and recoverable space vehicle.

Here, our program includes developments relating to Dyna-Soar, an advanced boost glide system, with application to the more sophisticated maneuverable vehicles being considered by ARPA. We see

an urgent requirement to move from the area of controlled orbits to the area in which space vehicles maneuver in and out of orbit and develop space flight performance similar to that currently enjoyed by manned aircraft in the atmosphere. During the coming year ARPA will sponsor work leading to advanced maneuverable vehicles, and it would appear that we shall be able to achieve many of our preliminary objectives in this field within the next 5 to 10 years.

While the NASA and ARPA program planning is logically aimed at the development of breakthrough technology necessary to stationing of such manned vehicles in space as may be required, we are proceeding rapidly with shorter term defense applications derived from our new-found capabilities for orbiting objects in space. ARPA has initiated programs in the fields of communications satellites, navigation satellites, cloud cover satellites, and early-warning satellites. In addition, it has assumed management control over the Sentry project, formerly known as WS–117L.

The research and development program for a communications satellite system is of 5 to 6 years' duration. This program was initiated by Project Score on December 18, 1958, when an Atlas launch vehicle placed a relatively simple delayed-repeater system into satellite orbit. ARPA orders have been issued for development of a highly sophisticated version of this system. Test of the new system will begin with satellite launches in a year or so. The satellites will be launched by IRBM-type boosters into 300 to 500-mile orbits. The system itself will have a communications capacity equivalent to 20 continuously available 100-words-per-minute teletype channels.

The Courier delayed-repeater phase of the communications satellite program will lead to relief of intercontinental electrical communications systems by handling vast amounts of routine traffic, thus freeing surface communications for top priority messages.

The later phase of the communications satellite program is the orbit repeater system. This phase will provide satellites capable of receiving and retransmitting messages on an instantaneous basis from 3,000 to 22,300-mile orbits. An ICBM-type booster will be employed to develop a capability to launch the instantaneous repeater payload into a stabilized 24-hour orbit at a 22,300-mile altitude. At this altitude, the satellite will complete 1 revolution around the earth every 24 hours, hence its characteristic of maintaining position over a given point on the globe when launched equatorially.

The instantaneous repeater will involve communications equipment of greater sophistication and capacity than that to be used in the courier delayed-repeater system. Most importantly, the instantaneous repeater system will provide intercontinental point-to-point communications, ground-to-air and ship-to-shore communications, and broadcast-type communications to ground and mobile units on an instantaneous basis. Optimum performace in receiving and retransmitting messages will be obtained by using 3 or 4 satellites equally spaced around the equator at 22,300 miles. The rapidity, reliability, and security of the point-to-point communications resulting from this satellite system represent breakthrough technology in terms of present military communications capabilities.

Our defense interests also dictate that we develop navigational systems employing satellites. Because vast areas of the world and its

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oceans are inadequately plotted, a more accurate, all-weather, space-based navigational system will be an essential component of world-wide military movements and operations of many types. In using satellites for navigation, we are really taking advantage of the satellite's similarity to the stars, which, as you know, have for a long time been important to navigational systems. The important navigational difference, however, is that a satellite can be fitted out with a radio source which can be heard and detected by any ship, airplane, or other object on the surface of the earth, at any time of day or night, and in good or bad weather. This will be of particular value to guidance of aircraft, surface ships, submarines, and space craft. Under our present program, we will begin satellite tests in mid-1959 and would hope to have initial systems in operation within the next few years.

Another of our space activities is the tactical cloud cover program. It is planned that this program will provide an answer to the present difficulties resulting from the lack of immediate weather information in inaccessible areas. Reliable weather information, especially cloud and surface wind conditions, is urgently needed. The satellite, by virtue of its ability to transmit rapidly over a large portion of the earth's surface, provides a potential answer to present difficulties resulting from lack of weather information. Under the program now underway in ARPA, the first launching will be attempted in mid-1959. Naturally, such satellites have important implications to scientific as well as defense interests, and this program will be transferred to NASA on July 1, 1959.

With the decrease in warning time brought about by the intercontinental ballistic missile, the Advanced Research Projects Agency is directing Project Midas, a program to develop an early warning system based on use of satellites.

ARPA became responsible for the Sentry program in June of 1958. In order to provide timely military information vital to defense planning, an orbiting satellite system has important ramifications.

It should be evident that we are rapidly approaching a time when the space population will consist of many radiating as well as non-radiating satellites in orbit. This Nation must have the capability to track all types of satellites and space vehicles. Furthermore, the long-range space program depends upon an adequate tracking and data acquisition network. Without an adequate tracking environment, the orbiting of experimental military satellite systems is, for all practical purposes, meaningless.

It is realized that such a system could become very expensive, and therefore careful coordination of the requirements of all potential users of such a network is required. During the past year, ARPA, with the assistance of the Jet Propulsion Laboratory, and since its foundation, NASA, has studied needs for worldwide space surveillance systems with a view to providing an overall program without unnecessary duplication. This work has recently culminated in a signed agreement between NASA and the Department of Defense for a general-purpose national system.

In essence, the agreement provides for four additional tracking and data acquisition stations for deep space probes and broad-band data readout to be located at separate oversea installations; two of these stations will be operated by NASA at the outset, and two by

Defense. Exchange of common data is provided in the agreement. The agreement also provides facilities for man-in-space and Minitrack stations which NASA will operate but will furnish data to Defense.

The need is recognized for two closely cooperative data reception and analyses centers; one operated, largely to meet scientific requirements, by NASA as a continuation and expansion of the Vanguard Center, and one operated, as a prototype to coordinate national defense surveillance requirements, by the Department of Defense. The latter is under Spacetrack management at the Cambridge Research Center. The two centers will exchange data freely and provide mutual support for the national program.

In addition, work on a satellite detection "fence" is being continued by the DOD. The purpose of this fence is to produce a capability for detecting, identifying, and predicting the orbits of all space vehicles passing over the United States. Construction is essentially complete on this experimental system, which involves both Minitrack and Doploc stations, extending generally across the southern part of the United States.

To provide backup for its many programs of vehicle, payload, and tracking development, ARPA is pursuing numerous programs for basic and exploratory military research involving auxiliary power systems, solid-propellant technology, and other space-related fields.

I hope that this rundown of our ARPA space activities and planning testifies to the fact that there are no limits imposed on our military space program by lack of desire or imagination or management control.

In closing, I should like to note that our defense space activities, necessarily oriented as they are to national security objectives, are a part of an overall national program in which the work of an overall national program in which the work of the National Aeronautics and Space Administration, in its area of responsibility, is correlated with that of ARPA, and in which both are interdependent and mutually supporting. I should like to assure you that the program and plans I have outlined here today are consistent with the work to be done at NASA and that the two agencies are working very closely to insure that the requirements of both are adequately supported in the overall national space program as developed under the President and the Space Council.

Thank you.

The CHAIRMAN. Thank you very much, Mr. Johnson.

That is really an amazing statement.

Now, the next witness we have is Mr. W. M. Holaday, Director of Guided Missiles, and Chairman, Civilian-Military Liaison Committee.

Now, Mr. Holaday, if you wish to proceed with your statement, we can question you following completion of the prepared statement.

STATEMENT OF WILLIAM M. HOLADAY, DIRECTOR OF GUIDED MISSILES, OFFICE OF SECRETARY OF DEFENSE, AND CHAIRMAN, CIVILIAN-MILITARY LIAISON COMMITTEE, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. HOLADAY. Mr. Chairman, members of the committee, I appreciate this opportunity to appear before you and to discuss the role which I have with respect both to the Department of Defense and to the National Aeronautics and Space Administration.

Dr. York has outlined to you my position as a special assistant to the Secretary of Defense in the guided missile field in which I will assist in providing an orderly transfer from the research and engineering phase into the production and procurement phases, and will monitor the production and procurement phases.

I would like to discuss briefly my position as Chairman of the Civilian-Military Liaison Committee, the activities of the Civilian-Military Liaison Committee, and finally, because I believe it will be of special interest to you, to touch on some of the highlights of the ballistic missiles program.

As Chairman of the Civilian-Military Liaison Committee I am responsible for assuring complete exchange of information and program coordination in the national space program as carried out by the Department of Defense and the National Aeronautics and Space Administration. To meet this objective I have directed my efforts toward making the Committee a functioning organization under which the key personnel of NASA and DOD are becoming familiar with the programs and program objectives of the two agencies.

While the Civilian-Military Liaison Committee is still in the very early stages of its operation, I am able to say that we have had four meetings to date and that we meet on a regularly scheduled basis on the second Tuesday of each month.

As a part of its operation, the Committee has initiated work which has resulted in a combined DOD–NASA study of the problems of tracking satellites. Prior to CMLC action, the National Aeronautics and Space Administration had its own tracking organization as well as certain plans for extending it, and the Department of Defense likewise had plans for certain tracking organizations. The results of the study, which is not quite complete, are such that an integrated plan for achievement of this capability from a national standopint is underway at the present time.

We expect that the CMLC mechanism will smooth considerably as the overall program becomes better established. The Committee will then be able to devote its efforts toward the achievement of a closely integrated program, making maximum use of the capabilities of both agencies.

With respect to the missiles, I plan to confine my remarks to the ballistic missiles program. In this area we are making extremely good progress, and as you know, have essentially completed our development programs for the Thor and Jupiter. The Thor has been deployed to the United Kingdom and we expect to deploy the Jupiter in the very near future. The achievement of the development objectives of these two programs is a real demonstration of the capabilities of our scientists and engineers in that they were able to start essentially from scratch and in a very short period of time solve the necessary problems and have available for deployment modern weapon systems.

In addition to the Thor, Jupiter, and Atlas programs we have, as you know, the submarine-launched Polaris intermediate-range missile and the Titan and Minuteman intercontinental ballistic missiles. We feel that all three of these missiles are proceeding in a satisfactory manner. Both the Polaris and Titan are now in the flight test stage and, while we expect some difficulties, we can say that we have not encountered any major problem areas in either of these two systems

which would give us cause for concern as to their becoming effective weapon systems.

The final missile I wish to discuss is the Minuteman intercontinental ballistic missile. I believe it is particularly important to place the Minuteman in the proper perspective at this time with regard to the other missiles because it does appear to be so attractive.

The Minuteman characteristics are specifically planned to be a second-generation intercontinental ballistic missile, taking into account all possible advances of the state of the technical art. Because it is being designed to have certain highly desirable characteristics, the Air Force has recommended and we are supporting a continuing high priority, orderly development.

While it is a second-generation ICBM, it should not be considered a replacement for the Atlas-Titan missiles. It will succeed in removing many of the limitations associated with these missiles, but it also does not have some of their capabilities which are needed from the military viewpoint. The program on which we are now proceeding under the highest Department of Defense priority is consistent with our aims to produce a Minuteman operational weapon system having the desired characteristics and at the earliest practicable date. Coming in a later time frame, Minuteman will combine with the Atlas-Titan-Polaris systems, giving us added flexibility and presenting in its time period a more positive deterrent to a potential aggressor.

In summarizing the ballistic missiles program, we are meeting our schedules, and we are continually reviewing our program to determine the desirability and feasibility of increasing or modifying our effort on these programs to maintain a balance in our overall total military posture.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much, sir, and I thank all of you three gentlemen for very fine statements.

Now, I want to ask Dr. York a few questions in reference to the program.

We have already probed rather deeply the question of responsibility in the Defense Department, and as I read the directive that Dr. York received on February 10, this directive in effect gives Dr. York full and complete—I could say dictatorial—authority to get this space program, especially the ballistic missile program, in shape so it will move forward with the utmost speed. That is correct, isn't it, Doctor?

Dr. YORK. My authority refers to all research and engineering programs, Mr. Chairman.

The CHAIRMAN. Well, the ones that we are especially interested in now, of course, are the ballistic missile and the space program.

What changes do you plan to make, Doctor, under the new authority that you have received from the Secretary of Defense?

Dr. YORK. Changes with regard to what, Mr. Chairman?

The CHAIRMAN. Well, first, the organizational setup. Do you plan any changes whatsoever?

Dr. YORK. My office, of course, is one which has replaced the prior office of the Assistant Secretary of Defense for Research and Engineering, so that the office will be composed and made up largely of the people who came from that office.

In addition, people from Mr. Holaday's office, the men that he had that were engaged in the research and engineering aspects of ballistic missiles will be transferred to my office.

Then I am in the process of trying to recruit some people from outside of the Pentagon to come in, with special reference to military systems, that is, to be able to work with me and the military departments on a group of military systems of special major interest.

The CHAIRMAN. You have no other changes in mind at this time?

Dr. YORK. No organizational changes within the office.

The other things I have in mind are attempting—and I have made some start at it—to develop a closer working relationship between the office and each of the military service research and engineering groups and, of course, with ARPA.

The CHAIRMAN. Now, you testified as to the million-and-a-half-pound-thrust engine. What do you propose to do, Doctor, to speed up that program?

Dr. YORK. Sir, Mr. Johnson testified with regard to the million-and-a-half-pound-thrust engine.

The CHAIRMAN. You did not testify yourself? I thought you mentioned it. Well, we will ask Mr. Johnson.

Dr. YORK. This is part of the space program, and under Mr. Johnson's management and responsibility.

The CHAIRMAN. Mr. Johnson, what is planned to be done to speed up that program?

Mr. JOHNSON. I have a reference here which I would like to refer to.

The CHAIRMAN. I might say, while the doctor is looking for the data he has in mind, that some of the questions that may be asked you gentlemen this morning may evoke classified answers. If that is the case, you are at liberty, of course, to refuse on the ground that it is classified material.

Mr. JOHNSON. Mr. Chairman, I brought up some figures to date this morning, knowing that this committee had visited Huntsville recently.

In our original program on the cluster that we agreed with General Medaris for funding in 1959 and 1960, it amounted to $63 million, $23 million of it for 1959 and $40 million of it in fiscal year 1960.

I have received information from him yesterday indicating that this activity could be stepped up, and that more funding could be intelligently used.

The CHAIRMAN. What did you receive in the way of information from him about speeding up that program?

Mr. JOHNSON. It would appear that we should proceed rapidly to build a launching pad at Cape Canaveral, and I have therefore asked from the Defense Department emergency funds in the amount of $7.6 million to build this launching facility, and Dr. York is approving this, and this will be transferred to the ARPA appropriation.

In addition, we are in 1959 committing $3.4 million for a long lead-time items. Therefore, the funding will grow from $23 million to $34 million.

The CHAIRMAN. Of course, that launching pad has to be built before you can launch a million-and-a-half-pound-thrust vehicle?

Mr. JOHNSON. That is right. We have a static test stand which is adequate to test the vehicle but not to launch it.

The CHAIRMAN. Proceeding as you are, what difference will you have in the timetable on the million-and-a-half-pound thrust?

Mr. JOHNSON. The timetable will be stepped up a little. It is hard to say at this time how many months, but certainly we will be able, I think, to go ahead with the four vehicles that we have ordered on a little earlier timetable.

The additional funding, however, which General Medaris and Von Braun and this group have suggested, amounts to adjusting the program in the upper stages, speeding up the upper stages, and these are being studied now.

As I say, I only received this information yesterday, and we are not in a position to fund it or to say that we can have a program for the upper stage development in the next couple of weeks.

The CHAIRMAN. They made this request of you?

Mr. JOHNSON. This is a recommendation to me based on requests I made of them to study the total vehicle in the upper stages as well as the cluster, itself, and to come to me with a program, a technical program. I have just received it.

The CHAIRMAN. And you say you are not in a position to fund it at this time but you hope to be in a few weeks?

Mr. JOHNSON. I hope to be able to decide in a few weeks whether this program, which they have submitted only with a broad sweep of the brush, is something we should proceed with. I do not have the detailed backup. You see, I received only a generalized communication yesterday.

The CHAIRMAN. Well, now, when you say you will be in a position to make a decision, does that involve Dr. York, too, or can you make that decision?

Mr. JOHNSON. No, I think I can make the decision as long as I have got the money. But the problem here is if we proceed with work now on the upper stages as recommended, we can't do anything about it in 1959; we couldn't add very much money to it in 1959, but in the 1960 phase it might require something like $15 million, which we do not now have programed.

This would mean that I, in the ARPA budget, would have to reprogram to get this $15 million directed in this manner.

The CHAIRMAN. Doesn't the ARPA budget have enough money to fund that request?

Mr. JOHNSON. ARPA's program is fluid, and I am quite sure if this turns out to be a good thing to do, we can reprogram within the ARPA budget. We will make every effort to do that.

The CHAIRMAN. You will pass on that in the next few weeks, and it doesn't involve Dr. York?

Mr. JOHNSON. That is right, sir. This is within the authority of ARPA.

The CHAIRMAN. Well, let me ask you about the Nike-Zeus program.

The committee expressed deep interest in the Nike-Zeus program because that seems to offer about the only program for actual defense of this country against the ballistic missile that we have at this time.

Since that is the case, tell us what change this reorganization will have in speeding up the Zeus program.

Mr. JOHNSON. I would like to refer this question to Dr. York.

The CHAIRMAN. Doctor, it is your question.

Dr. YORK. Sir, the Nike-Zeus program, in particular, and in fact the ballistic missile defense program in general, consists of a number of independent components handled by the various military services.

The Nike-Zeus program is a research and development program under the cognizance of the Army.

The CHAIRMAN. Well now, you have charge of that, don't you, under the new directive?

Dr. YORK. Yes, it is included in all research development test and evaluation.

The CHAIRMAN. Are you thumbs down on that program, as to speeding it up or are you going to get behind it and speed it up?

Dr. YORK. We do have plans to speed up the research and development program on Nike-Zeus, and on other related programs for ballistic missile defense.

The CHAIRMAN. Do you feel that that is such a vital program to our national defense that you are willing to proceed on that program on a production basis at this time?

Dr. YORK. Sir, the question of production would be one over which I don't have authority. My field is research, development, test, and evaluation.

However, I would not at this time recommend proceeding all out on the production of the Nike-Zeus.

The CHAIRMAN. Why wouldn't you recommend it, Doctor?

Dr. YORK. Because the development just simply isn't far enough along to enable us to know satisfactorily how we are really going to build a workable system. That is, we are all—certainly including me—of the opinion that it is of the highest national urgency to have a workable anti-missile-missile system. We think the best way to achieve that is to emphasize the research and development on the Nike-Zeus program, and as I said, other programs, all of which are being expanded, and at such time as the technical developments allow and further review can be made of the comparison of this program with other programs, we would then make the decision to go ahead.

In the meantime, we are studying the question of what measures to take in order to prepare long lead-time items, what measures we should take toward the development of production methods for some of the more difficult items, and so forth.

The CHAIRMAN. Well now, under our timetable the Russians will have perfected an ICBM before we will have production on a defensive weapon, the Zeus; isn't that right?

Dr. YORK. That is correct.

The CHAIRMAN. Well, what are we going to do during that period when we stand naked and unprotected against the ICBM?

Dr. YORK. We will have to rely, as we would have to do under any circumstances, rely primarily on our deterrent capability, that is, on the threat of retaliation.

The CHAIRMAN. You would rather rely on your deterrent capability than to take a calculated risk in proceeding with more dispatch on the Zeus program?

Dr. YORK. Sir, under the most optimistic assumptions, the Zeus program is not by any means—we cannot have the Zeus system ready to meet the early threat. We are getting here into some timetables,

and so forth, that perhaps we should reserve for an executive session.

The CHAIRMAN. If you would desire that, I would ask you in an executive session. But it has occurred to this committee that there will be a period of several years during which this country will not have a defense against an ICBM, and Russia will have perfected an operable ICBM.

Dr. YORK. Yes; but I am afraid there is nothing we can do about that.

The CHAIRMAN. Except take the calculated risk?

Dr. YORK. No, sir; we cannot have a Nike-Zeus system ready in time to meet the threat.

Mr. MCORMACK. Would the gentleman yield there?

The CHAIRMAN. I yield to the majority leader.

Mr. MCCORMACK. Assuming the Soviets perfected a defense against our intercontinental bomber, where are we then with the advantage you admit they will have on the intercontinental ballistic missile?

Dr. YORK. Assuming they had a perfect defense against the bomber.

Mr. MCCORMACK. They don't have to have a perfect defense, just the high attrition rate. Where would we be, connecting those two things?

Dr. YORK. We would be in a difficult position.

Mr. MCCORMACK. A sad position, wouldn't we?

Dr. YORK. Well, I am sure we will be able to get through any defense that is not perfect, and I am sure their defense will not be perfect.

Mr. MCCORMACK. You have to be realistic. These questions are not asked by any of us without being based upon profound respect for everything you are doing, but we still have our own concern. We all have our responsibilities, as you realize, but it is reasonable to assume they are trying to perfect a defense themselves against our missiles.

Dr. YORK. Against missiles; yes.

Mr. MCCORMACK. And isn't it reasonable to assume if they are trying to perfect a defense against missiles, that they are trying to perfect one against the bomber?

Dr. YORK. Yes, sir.

Mr. MCCORMACK. It would be much easier to perfect a defense against a bomber, going much slower, than a missile?

Dr. YORK. Yes, of course, that is the situation in this country, too. We do have under development and in production a system which would be of considerable value against bombers.

Mr. MCCORMACK. I know. I understand. But you have got my point, haven't you? If they perfect the intercontinental ballistic missile before we do, and they perfect a good defense against our bomber—you have to connect the two. I understand retaliatory force and the law of self-preservation. I understand that. If we have a retaliatory power, I can realize then that the law of self-preservation applies to them as well as to us. But suppose they get an advantage on us?

Dr. YORK. It is a question of how big the advantage is, and as far as our development programs are concerned, I don't think they have got that big an advantage.

Mr. McCormack. Well, have you got information to that effect? I won't ask you to give it, but are you satisfied in your own mind and in your own conscience, based on the information that you have, that that is so? Because the conscience involves 180 million Americans, you know.

Dr. York. Speaking in terms of research, development, test, and evaluation, which is the scope of my job, I am satisfied with what we are doing in round terms.

Mr. Teague. Mr. Chairman.

The Chairman. I am just going to ask you one more question, and then I am going to call on Mr. McCormack. He may have to leave a little early. I want first to express the feeling that we are proceeding in the right direction in getting some order out of chaos that has developed in the ballistic missile program.

I want to say that I hope you use your authority, sir, and that you are able to cut down the leadtime on some of these programs and the time for decision.

We have heard a great many complaints about the slowness of decision in the Pentagon. Now, you have the authority, it seems, under this new directive, and I want to express the hope that we do get quicker decisions, and we reduce the leadtime.

I believe that is all.

I will recognize Mr. McCormack.

Mr. McCormack. Well, I will be here for a little while, so recognize some of the other members.

The Chairman. Mr. Fulton.

Mr. Fulton. I am glad to have you gentlemen here, and I think you are doing a good job.

Of course, on any shopping list for weapons you can't have them all, you can't make them all, and that has always been the case in any military system; is that not right?

Dr. York. Yes, sir.

Mr. Fulton. So that what we have to do is decide the ones which at the particular time will give us the most defense or the most bang-bang for the dollar; isn't that the case?

Dr. York. That is always true.

Mr. Fulton. Then, likewise, operating on our security estimates and our Central Intelligence Agency reports as to what any possible enemy is doing, we then come up with an opposite force which neutralizes; isn't that correct?

Dr. York. Yes, I believe so.

Mr. Fulton. So that we are really estimating ahead; and there can be a difference, a legitimate difference of opinion as to what the future will hold; is that not right?

Dr. York. Yes. It is a most difficult problem to anticipate both their accomplishments and our requirements in the face of those accomplishments.

Mr. Fulton. And in making up the budget, you have to look at the total overall picture of the economy of the United States inflation, and what you are going to extract from the taxpayer, too, in taking into account what the Department of Defense should do, both on research aid development as well as on operations and manufacturing missiles, is that not right?

Dr. YORK. Yes, sir; although such matters as inflation, and so on, don't come under my cognizance.

Mr. FULTON. But the basis of decision is broader than just a particular weapon or a threat in one year in the future, is it not?

Dr. YORK. It certainly is.

Mr. FULTON. Then there is no doubt, I believe, that we would concede that the Russians have, say in 1960, more ICBM missiles than we will have Atlases and Titans; isn't that correct?

Dr. YORK. I believe that is the conclusion based on the information that we know, that the Russians could have more ICBM's than we will have Atlases and Titans.

Mr. FULTON. But at the present time we are pretty well up on our defense on the short-range missiles, the Honest John, the Corporal, the Sergeant, and the Redstone, which we don't think they have anything like, as against their T–8, T–5, the Comet, and the T–7, and I think we have an edge at Redstone under von Braun.

Dr. YORK. I am not sure that we really do.

Mr. FULTON. Well, I am trying to help you. You should say yes.

Mr. MCCORMACK. Well, you want him to tell us what he is thinking.

The CHAIRMAN. I want to commend the witness for his candor. I think that is what the committee wants.

Mr. FULTON. I would commend him for his modesty, but I don't want him to be overmodest, because we are talking about the estimates as to short-range missiles, and while it might be a very becoming thing to have modesty before this committee, it might not be too good when we come to the propaganda and psychological war we are in, to not be sure that we are ahead of them on the Redstone missile, which of course we are.

Then on the intermediate-range, of course we have the Pershing and we are going to have the Polaris, the Thor, and the Jupiter. We were down at Redstone Arsenal, and I want to compliment the Redstone Arsenal, and the Ballistic Missile Agency, for their progress.

The Russians have the T–1, the Comet–2, the T–4, the Goadem–2, and the T–2. I believe with our progress on the Thor and the Jupiter and with our moving into cluster on the latter, we are really making fine progress in relation to them, aren't we?

Dr. YORK. Our progress relative to theirs is something I think we can be proud of at the present time.

Mr. FULTON. Because it has been under ARPA previously, I ask Mr. Johnson, on these shorter range missiles, we are stacking up pretty well with the Russians, aren't we?

Dr. YORK. They have not been under ARPA, short-range missiles.

Mr. FULTON. On the previous question, I am speaking of, on the shorter range missiles, the Honest John, the Corporal, and the Redstone, of the United States, we stack up pretty well against their T–5–B, their Comet-1, and the T–7 of the Russians?

Mr. JOHNSON. It is my personal opinion, yes; but as Director of ARPA, missile production, missile development, was not under our cognizance, so I can't speak as a Director of ARPA, but I speak as an individual.

Mr. FULTON. Well, who can speak as to that?

Dr. YORK. Sir, ARPA is responsible for the space programs of the Department of Defense and responsible for certain advanced ballistic missile development and research programs and for certain programs in solid-propellant chemistry. It is not, and never has been, responsible for short-range missiles.

Mr. FULTON. No; but who is in a position to give a calculation of the security base of this country on these various missiles, the short range, the intermediate range, and ICBM fields? Who do we ask as to that?

Dr. YORK. You would go to CIA, I suppose, as to getting the intelligence picture and ballistic picture on these things.

Mr. FULTON. Well, don't you fellows calculate the punch on the research and development you are doing on your own weapons as compared to what the other fellow is doing, or are you just doing them in a vacuum?

Dr. YORK. That is true.

Mr. FULTON. Then we are coming up with the solid-fuel Minuteman, so in 1962 we will have these solid-fuel Minutemen deployed around the earth in bombproof shelters and at shorter ranges than the Russian's ICBM's. Won't we be able to knock anybody's block off, regardless of ICBM's?

Dr. YORK. Not in 1962 for the Minuteman.

The CHAIRMAN. Doctor, may I interrupt for a moment. The members at each end are not able to hear your replies. If you could speak just a little louder we would appreciate it.

Mr. FULTON. Well, we will have the Minutemen in 1962, but we will only have them in large numbers in 1963?

Dr. YORK. Sir, these deployment dates for weapons systems like Minutemen are all classified information as far as we are concerned.

Mr. FULTON. Well, I have from outside sources than you, and I believe that by 1963 we would be well along with the Minuteman program.

Mr. OSMERS. Mr. Chairman.

The CHAIRMAN. If that is classified, we will get into that in executive session.

Mr. FULTON. All right. Then on the appointment of this Space Council, there is a Space Council to be appointed of nine members—Eisenhower, Dulles, McElroy, and six others. They were to have an executive secretary. Has that executive secretary post been filled yet, because that is where the overall policy is set on space. I am going to ask you what your contact is with that Council.

Dr. YORK. My contact has been rather minor with that Council because Mr. Johnson usually handles those matters or Mr. Holaday, who is Chairman of the CMLC. I do have contact, of course, with it. As far as I know, there is no executive secretary appointed under the terms that the law allowed.

Mr. FULTON. Under NASA, National Aeronautical and Space Agency, there is Phillips who is a temporary executive secretary of the Council, is that not right?

Mr. JOHNSON. I do not think he is temporary. I think it is a full-time job.

Mr. FULTON. Well, has his name been sent up to the Senate, because it requires Senate confirmation?

Mr. JOHNSON. That I do not know.

Mr. FULTON. Then, in addition to that, the three other employees, have they been hired to get that into operation?

Mr. JOHNSON. I do not have that information.

Mr. FULTON. Well, I hope the Administration moves in that field. Now finally there has been a recommendation evidently that a gentleman from Texas named Mahon has said there should be $700 million more spent in the current fiscal year for missile work and that we will then be catching up with the Russians. Is that correct; is it necessary; and if not, why; and that is my last question?

Mr. HOLADAY. The question that you put as to the $700 million, I read that in this morning's paper, there are many items in connection with advancing this program besides just building the missile. It is true that we could increase production of Atlas missiles. We could probably step up or start to step up the line on the production of Titan missiles. However, this is only one phase of the problem of deploying missiles. We have to relate this to our ability to construct bases, the type of base we construct. It also has to be related to the training of personnel, so I can say to you that there could be, if we made the money available, an increase in production but we better have our military advise on this question before we plow ahead at a very rapid rate.

There are many factors as to the construction of bases and training of personnel that must be taken into consideration in any problem of this type.

Mr. FULTON. Could you then give us a formal statement by the Department of Defense on this particular question for our committee record at this point?

Mr. HOLADAY. I think our Department of Defense is pretty well on record at the present time that we are supporting the present program we have, in the form of the present budget for 1960.

Mr. FULTON. That is all. Thank you.

The CHAIRMAN. Mr. Teague.

Mr. TEAGUE. Dr. York, the Army has responsibility for the Nike-Zeus?

Dr. YORK. That is correct.

Mr. TEAGUE. Have they recommended going into production?

Dr. YORK. The Army did recommend going into production last fall.

Mr. TEAGUE. And what are the reasons for not going into production?

Dr. YORK. Sir, I would rather not expand on that any more than I did for the chairman except in executive session because this involves the question of dates things might be ready, and what are the difficulties, and so forth.

Mr. TEAGUE. Is it more from a budgetary standpoint or scientific standpoint?

Dr. YORK. As far as I am concerned, it is from a technical standpoint. It is a question of what point we have reached in the program and is it now timely to begin an all-out development program.

Mr. TEAGUE. According to a Sunday paper the best scientific brains have recommended against going into production. Have there been some scientific brains who have recommended going into production?

Dr. YORK. Let me exclude the people working actively on the project, because you would expect that the people working on it would be enthusiastic about it. You will always find that. Excluding those, there have been some who felt it was worthwhile going ahead, but of the ones I have talked with, it certainly is overwhelmingly the other way.

Mr. TEAGUE. Doctor, is this the only antimissile missile that we have, that we are working on?

Dr. YORK. It is the only antimissile missile that is in a development stage. The Advanced Research Projects Agency is doing work which is being expanded in research and development of other aspects of missile development. You may want Mr. Johnson to expand on that. In addition, there are programs as to missile detection which are of interest in connection with missile warning, missile defense, and also defense of SAC, and so on. These programs are generally also being expanded at the present time.

Mr. TEAGUE. What would you have to lose if you went into production now? Would you not gamble more on gaining than losing if you went into production now?

Dr. YORK. If it did not work and we deluded ourselves that it would, we would lose a great deal. When you take a research and development program and decide now is the time to produce, the record essentially is no matter how hard you try the research and development slows down, the design is frozen and you go ahead and if you go ahead at the wrong time with a system that has not yet been proved out or very few components of which have been proved out, if you go ahead too early you end up behind and not ahead.

Mr. TEAGUE. Where does the Nike-Zeus compare with your Thor, your Jupiter, your Polaris, the rest of them?

Dr. YORK. The Nike-Zeus rocket per se is the least difficult part of the system. The Nike-Zeus rocket is something which we could build with no difficulty, but the Nike-Zeus system is very much more than just a rocket. It consists of radars, computers, other things of that sort, and it is on this side where the development is, in my judgment and that of most other scientific people I have talked with, not at the stage where it is ready to go ahead.

Mr. TEAGUE. Mr. Chairman, I have no other questions.

The CHAIRMAN. Mr. Osmers.

Mr. OSMERS. Mr. Chairman, before I ask my two questions I would like to make an observation quite respectfully. If the committee is going to question witnesses such as we have before us today on such matters as timetables, relative development, and possible gaps in defense, and so on, that testimony should be taken in executive session, and then it should be released to the public or we should release to the public only those portions of the testimony that will not reveal anything of help to the enemy about our defense posture. Now I realize when people say "Yes," or "No," or "I cannot answer in public hearings," these things have certain meanings to the enemy that they may not have to some members of the committee. I have two questions.

Mr. FULTON. My questioning was based on magazine and newspaper reports published on the basis of statements from other Department of Defense officials.

Mr. OSMERS. I did not specifically direct myself to you, Mr. Fulton, but now that you have mentioned it, I will say to you the fact that there are magazine articles means that there are magazine articles, but when you ask these three Americans about the dates, their answers or their failure to answer has a significance that is entirely different from a magazine article.

Now my two questions are these, Mr. Chairman.

Mr. FULTON. Now wait.

Mr. OSMERS. I do not intend to debate the issue. I permitted you to ask question after question after question most of which turned out to be statements of lists saying they have this and this and this, and they were not seeking information at all.

If you do not mind, Mr. Fulton, I would like to ask my two brief questions. They are one, do you gentlemen feel that you have available to you sufficient enemy intelligence, general intelligence as to what the enemy is doing in your field to be able to intelligently direct programs under your direction?

The CHAIRMAN. Who wants to answer that? Dr. York, do you want to answer that?

Mr. OSMERS. You can answer it individually or one of you can answer it.

Dr. YORK. By and large, I think we probably do have enough intelligence to make up an intelligent program of our own. There certainly are things that we would like to know that we do not know, but I think the consensus is we know enough so that we can have an intelligent program.

Mr. OSMERS. Mr. Chairman, does Dr. York feel that he has available all of the information that is available to the country in this field? Let us put it that way. I am sure no one has all of the information he would like to get.

Dr. YORK. I feel that I have a good—I do not know whether it is all, but it is a pretty good fraction.

Mr. OSMERS. The second question, Mr. Chairman, is based on the information that is available to these three scientists in their various capacities: Do you feel that the programs of this Nation, with respect to the various fields in which you operate, are sufficient, taking into consideration the intelligence estimates, or not?

Dr. YORK. Do we feel that the programs are sufficient as they stand?

Mr. OSMERS. That is correct; adequate is the word I would rather use than sufficient.

Dr. YORK. I think as far as I concerned, which is the overall research, development, test, and evaluation, that it probably is adequate. Of course, the purpose in our being here and the purpose in our being in our jobs is to try continuously to improve the situation. I have only recently moved into my present job. I have not by any means reviewed everything that is going on. I am in the process and will be for the rest of my tenure in the process of reviewing what is going on. I, however, know the people who have been in charge in the past, in the Office of the Secretary of Defense, and the people who have been in charge in the military departments of the various programs. I know them quite well and I have unbounded confidence in them. I think the programs are adequate, the overall program.

Mr. OSMERS. Do the other two witnesses——

Dr. YORK. That is not to say it cannot be much improved.

Mr. OSMERS. Do the other two witnesses in general subscribe to Dr. York's feeling in that regard?

The CHAIRMAN. Mr. Johnson.

Mr. JOHNSON. Mr. Congressman, in the area in which I have responsibility I do feel that we are, first, getting twice as much information, intelligence information, from what is going on in Russia than the cynics think we are, and half as much as I think we ought to get.

Secondly, based on the information that is available—and I think all of the information that is available has been given to me; I am visited frequently by the people who communicate this information—based on this, I think that the programs we have initiated in the two significant areas that I am responsible for, one being space military technology and the other being advance research in our defense from ballistic missiles, that we are doing everything that we can now do and I do think at the rate we are going if we are behind the Russians that we will overtake them in a reasonable period.

The CHAIRMAN. What about you, Dr. Holaday?

Mr. HOLADAY. Well, since both of these fellows said "Yes" in several words, I will say "Yes" to both questions.

The CHAIRMAN. I will ask this question: What would you call a reasonable period in which to overtake the Russians?

Mr. JOHNSON. Well, it is my feeling in the areas in which I am responsible that we can at the rate we are going overtake the Russians in space technology and I think technically have on paper a reasonable defense from the missile in the next 3 to 4 years.

The CHAIRMAN. Mr. Osmers, do you have further questions?

Mr. OSMERS. Not at the moment.

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. All right, Mr. Anfuso.

Mr. ANFUSO. Gentlemen, it is my frank opinion that the Russians pretty much know about our programs. They know about our failures and what we are trying to do. I do not think that so far we have hidden anything from them. That is the way democracy works and I am afraid we cannot improve on it. I am in great favor of this democratic way of approaching things and I am in great favor of letting the people know just what our failures are and I think if we do that the public will follow us in this program, will follow you gentlemen.

Now without revealing anything to the enemy, and I do not think we are, can you gentlemen tell the American public at this time whether we have the balance of power, taking everything into consideration, our Strategic Air Command, our atomic bombers and everything?

Dr. YORK. Sir, within our capabilities to judge this question which is beyond what we are normally charged with by quite a bit, we believe that we do have the balance of power at the present time.

Mr. ANFUSO. And you are basing that on the intelligence which you have received from CIA, which you gather every day, I assume, and you are basing that, I suppose, on our Strategic Air Command, is that right?

Dr. YORK. We are basing it to a very large extent on the fact that the Chairman of the Joint Chiefs of Staff said "Yes" and this is in his field of responsibility.

Mr. ANFUSO. Well, now our main force at the moment is our Strategic Air Command, is it not?

Dr. YORK. That is our main retaliatory force.

Mr. ANFUSO. Would you say there is a possibility of atomic bombers becoming obsolete in the near future?

Dr. YORK. You mean large bombers carrying atomic weapons?

Mr. ANFUSO. Yes.

Dr. YORK. In the future two things will happen. One is it will become more difficult for bombers to penetrate. Defenses will be improved. On the other hand, the bombers are being improved, to fly higher and faster. So a bomber like the B–47 will eventually go the way of the B–36, namely become obsolete, but of course we are working on much faster and more sophisticated bombers and I assume they are too. In addition there is coming along, as I think everyone has been hearing, the ICBM, which will come along, which will certainly augment the bomber; whether it will replace it or not, make it obsolete or not, is another matter. I think it will not in the foreseeable future, but the ballistic missile will certainly augment the bomber.

Mr. ANFUSO. Now, Dr. York, if the Russians get ahead of us on these ICBM's, if they produce enough, say 300 or so, much before we can, are we not in danger of losing the next war?

Dr. YORK. Sir, that comes outside the field of research and engineering. All I can do is say the military experts in the Pentagon, the Joint Chiefs, have said that the situation is not as bad as some of the critics have painted it.

Mr. ANFUSO. Secretary McElroy after testifying before the Senate gave this conclusion which I think has been reported by the papers: That we are so far ahead that in 2 years we will catch up with the Russians. Now I would like to ask you one or two questions regarding this airspace that you spoke about, Mr. Johnson. Before I ask you that, you have heard Dr. York testify, you have heard his statement before this committee, are you in full accord with it?

Mr. JOHNSON. The statement in its entirety?

Mr. ANFUSO. The statement he made as to jurisdiction.

Mr. JOHNSON. Yes, I am.

Mr. ANFUSO. So there is no more quarrel about that as to who is ahead of whom or anything like that?

Mr. JOHNSON. Mr. Congressman, the quarrel exists in the minds of the newspapermen. I do not understand that.

Mr. ANFUSO. It never existed between you?

Mr. JOHNSON. Never.

Mr. ANFUSO. I am glad to hear that.

Mr. JOHNSON. I get furious at this line of interrogation because there is no quarreling and I do not understand it. Somebody wants to find a fight.

Mr. ANFUSO. Mr. Johnson, I want to give you this opportunity to make a full statement.

Mr. MCCORMACK. I think you welcome the question he asks to give you an opportunity to blow off your steam.

Mr. JOHNSON. I certainly do. There is more quarreling in American industry than there is in the Department of Defense. I have

been down here from industry 1 year and I have gotten more done in 12 months down here than any 12 months in industry.

The CHAIRMAN. May I say this, however: When you make the statement we will not be able to catch up with the Russians for 3 or 4 years, I think the American people do have something to worry about.

Mr. JOHNSON. Agreed, but this is a question that money alone cannot solve. This is a question of the work they did over the last 15 years that we are now catching up with and money and management skills alone are not the answer. We are going to need a little time, and I think this is the time that we will need, but I do believe in this period that we are talking about, that we do hold the balance of power.

Mr. ANFUSO. Mr. Johnson, if the chairman is through——

The CHAIRMAN. Yes, surely.

Mr. ANFUSO. Mr. Johnson, you refer to this tactical cloud cover program. Are you gentlemen represented in this Interdepartmental Committee on Weather Modification?

Mr. JOHNSON. Dr. York represents the Department of Defense in that, yes.

Mr. ANFUSO. Now do you feel that we are doing enough in this weather forecasting and regulation—and I say that in view of the certain statements which have come to me that the Russians are planning to change the climate over their own country. They are planning to change the climate over the Arctic Ocean, and some of our scientists say if they were able to do that even New York City would be under water as well as the entire Northeast.

Mr. JOHNSON. We do not have a responsibility as to weather control, but from where I sit and from work I was familiar with when I was in industry, I believe any claims on the part of the Russians or on the part of magazine writers that Russia will attempt shortly to do these things is overstating the ability and overstating any intention that they have. I think this is something we are overrating, but I do think there is a great opportunity as time goes on to do things with weather control that are not now visualized, but I do not think this is going to happen overnight.

Mr. ANFUSO. Well, if they are able to do these things we have some other form of danger, where cities can be inundated without the firing of an intercontinental ballistic missile; is that correct?

Dr. YORK. That is correct, if you could melt the polar icecap, you would flood New York City, but that is an old scientific notion, and not something of recent origin. The fact someone in Russia says that does not scare me.

Mr. ANFUSO. Do we have an obligation to go into this weather forecasting to a greater extent than we are? We are spending something like a million and a half dollars. The whole committee here thinks that is inadequate.

Dr. YORK. Weather forecasting and weather control are two quite different things. We are spending more money on weather forecasting. The meteorological satellite program, the one Mr. Johnson referred to, and the NASA program later, that is considerably more than a million and a half dollars; and they represent important steps forward in the techniques of gathering weather information, enormous steps forward.

Mr. ANFUSO. Do you regard it as possible someday to be able to control weather, direct hurricanes in a different direction, or bring about storms?

Dr. YORK. Well, there are various degrees. Bringing about storms is probably something nearer than diverting hurricanes, and I think we will learn more about this. We have already made tentative overtures in that direction in the cloud-seeding programs.

Mr. ANFUSO. My last question is: The bringing about of storms might change some of your calculations as to the accuracy of our intercontinental missiles?

Dr. YORK. I do not understand that point, sir.

Mr. ANFUSO. Well, if we are able to create so many storms over the atmosphere, is it not possible that the calculations which you scientists are making as to the accuracy of our intercontinental missiles may be changed?

Dr. YORK. I do not think there would be very much connection there, sir, although I may not have understood the question.

The CHAIRMAN. Mr. Van Pelt.

Mr. VAN PELT. Mr. Holaday, on page 2 of your statement you say the Thor has been deployed to the United Kingdom. Does that also include personnel?

Mr. HOLADAY. Yes, sir. There are differences in the plan of deploying these. Some of them will be deployed, of course, where we use our own personnel. Others will be where we go in and train the personnel of the particular country in which we are deploying. This is true in England. We are training their personnel and they will deploy the missiles.

Mr. VAN PELT. Well, are some of these countries, our friends, as concerned with the intercontinental ballistic missiles as we are, and if so, are they proceeding with their own program?

Mr. HOLADAY. Sir, the British in their recent white paper which they issued on ballistic missiles indicated they would continue the development of their missile known as Blue Streak which is an IRBM missile. We are currently also carrying on and providing technical information for the other countries in Europe, if they wish to develop an IRBM, and I might point out there is considerable interest throughout all of Europe on the deploying and developing of their own IRBM missiles.

Mr. VAN PELT. Would they at any time be able to go into production of some missiles we have developed?

Mr. HOLADAY. Yes, sir, although there are many problems to be solved in that. We believe technically and from a manufacturing viewpoint there is no reason to believe they could not proceed with a development and production program. We would have to give them considerable help, even up to the point of maybe having to supply them with some of the specialized equipment, but there is no reason why the European countries could not develop, manufacture, and deploy missiles of this type. There are also ways and means in which we could aid and assist them through our military aid program to shorten the time period on that by passing to them technical information and also supplying them with some of the specialized equipment.

Mr. VAN PELT. Thank you. That is all, Mr. Chairman.

The CHAIRMAN. Mr. McCormack has to leave early and I am going to call on him now.

Mr. MCCORMACK. You said you do not have authority over production, is that correct?

Dr. YORK. That is correct.

Mr. MCCORMACK. Who does?

Dr. YORK. The Secretary of Defense.

Mr. MCCORMACK. Well, are you not his man?

Dr. YORK. No, sir, for research, development, test, and evaluation I am his principal staff assistant.

Mr. MCCORMACK. I see; in other words research and engineering activities, how would you define the words "engineering activities" in your directive?

Dr. YORK. Well, the word "engineering" is expanded—there is an expanded version which is research, development, test, and evaluation, which covers research and engineering. In that case engineering means development, it means testing items which are to go to operational use, and so forth. It means working out where necessary production procedures but it does not include responsibility for production.

Mr. MCCORMACK. Well, who does the Secretary of Defense delegate it to?

Dr. YORK. The Secretary of Defense on matters such as production and deployment makes the decision himself after consulting the military services and the Joint Chiefs of Staff.

Mr. MCCORMACK. Then he delegates it to some branch, to some one of the services or to you?

Dr. YORK. No, not to me. In no case would it be delegated to me. If it is the Atlas missile, it is the Air Force; if it is the Jupiter missile it is the Army that actually carries out the production.

Mr. MCCORMACK. Well, there is a little vacuum there; is there not?

Dr. YORK. I do not think so.

Mr. MCCORMACK. All right. Well, Doctor, I noticed one of these directives says recommend, develop, plan—all different words.

Dr. YORK. You are looking under the heading "Functions."

Mr. MCCORMACK. Yes.

Dr. YORK. Where it becomes necessary to spell out the authority, it is contained in a different section.

Mr. MCCORMACK. These questions are only to get information. We are not being critical. I am trying to get information. I think what has happened is a very good thing. By the way, I did not take much stock in the clash between you two gentlemen. I think you ought to welcome the opportunity to clarify that, Mr. Johnson.

Mr. JOHNSON. I did; yes.

Mr. MCCORMACK. Now one of the duties you have under subdivision 8 of the functions is to contract with private business entities, educational or research institutions or other agencies of Government, and it is again referred to under relationships, maintain and arrange for the maintenance of active liaison with appropriate research and development agencies outside of the Department of Defense, and so forth, indicating that there is a great importance attached to that at the top level, is that right?

Dr. YORK. Which part were you referring to?

Mr. McCormack. Subdivision 8 of the functions, page 2, and then on page 4, paragraph 5, under the heading of "Relationships."

Dr. York. Yes, this is one of the items included within my authority. What was your question concerning?

Mr. McCormack. You consider that a matter of top level consideration?

Dr. York. Yes.

Mr. McCormack. Because private industry spends a lot of money, too?

Dr. York. Yes; indeed, they do.

Mr. McCormack. Some billions of dollars, and they are doing a grand job. We have got to give credit where credit is due; is that correct?

Dr. York. Yes, sir.

Mr. McCormack. Does the DOD tap the full potential of private industry by capitalizing on their reported annual expenditure for research and development?

Dr. York. Well, we certainly try to.

Mr. McCormack. That is all you can do. I understand that. I just want to get this for the record.

Now, they spend several billion dollars a year, too, private industry?

Dr. York. Yes; on research, development, and engineering.

Mr. McCormack. Then where they have proprietary rights do you protect them?

Dr. York. Yes, although I must say this: I am not personally very familiar with some of these legal matters, but we have what I am sure is very good legal counsel on these things.

Mr. McCormack. Is there a higher office in the Department of Defense on your level which establishes and maintains a close working relationship with industry, research management, to assure that the interchange is vigorous?

Dr. York. We intend to and, of course, each of the services and ARPA also works on that.

Mr. McCormack. On the defense level, if not, you intend to?

Dr. York. Yes, and I have to admit I do not know the extent to which this is done.

Mr. McCormack. I understand. But you recognize the importance of this, of getting all information possible from private industry in connection with the research done by the Defense Department or any of the branches thereof?

Dr. York. Yes, sir.

Mr. McCormack. The only reason I ask these questions—you attach great importance to that. I want to call your attention to this—you do not have to answer, but simply look into it: I notice in the reorganization or regrouping in the Air Force—and I have a copy here which I will give to you; I would like you to look into it—that until about 3 weeks ago this activity was up on the command level Now under the new reorganization it is not even mentioned. It is demoted to a part of the technical services in which it, with four other activities, are incorporated, indicating that while you attach——

Dr. York. What is the name of the activity in here?

Mr. McCormack. Well, the activity was—about 3 weeks ago it was in a high level known as Industrial Relations Division and was

headed by Warren L. Baker. Do you know Mr. Baker? I do not know the gentleman.

Dr. YORK. Not personally.

Mr. MCCORMACK. He was head of the aviation division of Socony Vacuum of New York for many years. I imagine he was a very fine man. In this new regrouping or reorganization, whatever you want to call it, from a high command level it has been placed in a category where it is not even mentioned, and in fact it is a part of a consolidation with the Directorate of Technical Services. That is my information. It would seem to me with private industry spending billions of dollars for research and development there should be a very close relationship always between the Defense Department and its component parts and private industry to find out what they are doing and how it might be related to what the military is doing.

Dr. YORK. Well, sir, I cannot speak for this particular reorganizational question, as to what the Air Force has done, but I do know that in the research and development branch of the Air Force they do pay very close attention to this question of what is going on in industry, what is going on that they can make use of, and so forth. Whether it is named as being part of a box or not, I am sure that they do that.

Mr. MCCORMACK. Well, this is something that you could look into it; is it not?

Dr. YORK. Yes; I could.

Mr. MCCORMACK. Would you do that?

Dr. YORK. Yes.

Mr. MCDONOUGH. Will the gentleman yield at that point?

Mr. MCCORMACK. I would be glad to.

Mr. MCDONOUGH. If private industry is working as assiduously as is indicated on matters of defense and military progress, they certainly are not doing it in the dark. If they have something they come to you or to the Department and inform you of what has been done.

Dr. YORK. If they have what they believe is a good idea and something which should be expanded upon in a way that is beyond their resources, yes, indeed, they come in.

Mr. MCDONOUGH. Well, they certainly should not be lax in that respect.

Dr. YORK. They are not timid about it at all.

Mr. MCDONOUGH. Do most of the proposals originate in the Department or are they originated in private industry?

Dr. YORK. I would not know as to "most." Certainly an important fraction comes from both sources. I do not happen to know myself which is the most.

Mr. MCDONOUGH. Well, that is an important thing in my opinion for the reason that, if the defense is not first alerted to the requirements, we certainly should not depend on private industry to initiate them.

Dr. YORK. No, actually proposals are something which are not born full-blown, the new idea. Normally what will happen is one of the services will put out a request of some sort for a feasibility study or something of that kind, or make a request of one of its operational research organizations to come up with a proposal. Industry may hear about that, or at the time a request for feasibility studies is made, it is generally known that the Department is interested in something

along that line. Industry may add to it, expand it, change it around a little bit, come in with a proposal. It is hard to put your finger on the time exactly and from what source a new proposal or new idea arises, because it grows in a gradual way.

Mr. McDonough. Well, as I recall the history of our military progress over the years, it has been traditional that industry has been far ahead of the Defense Department and the Defense Department has been slow in adopting things that were more effective than the things they were actually doing.

Dr. York. Well, there has been a radical change in the last 20 years with regard to matters of that sort.

Mr. McDonough. Thank you.

Mr. McCormack. No further questions.

The Chairman. Mr. Bass.

Mr. Bass. No questions.

Mr. Sisk. Mr. Chairman.

The Chairman. Mr. Sisk.

Mr. Sisk. Mr. Johnson, I would like to inquire as to what you feel to be your working relationship with NASA. To what extent are ARPA and NASA cooperating and coordinating their efforts and so on? Would you make a comment on that?

Mr. Johnson. Our relations with NASA, which a lot of other people would like to find bickering and quarreling in, are very good. The relationship I think could not be better. There is no reason at all to think that this relationship will not remain on this kind of level. I see no problems organizationally in getting the total space program conceived and put into effect. I deplore the conversation that there ought to be more reorganizing in this effort, we ought to start over again. I think this is completely unnecessary. I think things are going very well and I am quite sure that my associates in NASA would say the same thing.

Mr. Sisk. I would like you to comment, Mr. Johnson, on a statement I am going to read to you from an issue of "Management" which just came out. I am sure you are familiar with the publication. It has to do with a statement made by Dr. William H. Pickering. Are you familiar with him? I am certain you know who Dr. Pickering is.

Mr. Johnson. Yes.

Mr. Sisk. He made the statement in Philadelphia that fighting between research organizations, NASA and others, threaten our chance to achieve a unified space program. He said "That is our real problem," then he went ahead pointing out that the United States largest successfully fired missile was about the size of Sputnik I. He says we are behind them because they have a more unified program. I am not trying to create an atmosphere of controversy, we want to do away with the atmosphere of controversy, but Dr. Pickering is a respected man of our scientific community and a man for whom I have high regard. This is a recent statement and I think it is important that this committee be informed as to what the relationships are, and I think it is important that you people are getting along in the overall state program.

Mr. Johnson. If Dr. Pickering made the statement, a good question to ask is when. If it was made recently I am surprised. I think in an organization as large as NASA, and ARPA has 60 or 70 tech-

nicians, you will find individuals who call it bickering when their method of doing is not the way it is done. I do not know that Dr. Pickering had one of his pet projects turned down and therefore called it bickering, but I think when a mutual program is agreed to, all of the troops get behind it and execute it promptly and stop any bickering that may have existed prior to the policy decision. I am therefore a little bit concerned as to when Dr. Pickering made this statement and under what conditions.

Mr. SISK. This statement, Mr. Johnson, was quoted as having been made in Philadelphia about 3 weeks ago, when he was there to receive the award from the National Reliability and Controls Symposium on Space Technology. That was about 3 weeks ago in Philadelphia at the time he was up there to receive that award; in answer to questions from the press as to some of the problems, he made the statement, that frankly he felt our greatest problem was in fighting or controversy. I think that it is important, if it exists.

I wanted to ask you this further question: Are any of you three gentlemen members of the Space Council?

Mr. JOHNSON. We are not. The Department of Defense is represented by Secretary McElroy and Secretary Quarles is the alternate.

Mr. SISK. Well, now can either of you two gentlemen, particularly you, Mr. Johnson, because you head ARPA you should know about this, tell us how many cases of referral to the Council for settlement of differences have there been?

Mr. JOHNSON. None to my knowledge. I think that that is a correct statement, that there are none. I know this: All of the differences have been ironed out at the level of Dr. Glennan and myself and in some cases we have had conferences with Secretary Quarles and Secretary McElroy.

Mr. SISK. You are familiar with the language under section 201 of the act providing for the Council and what its duties are with reference to the performance of these. Now, for example, No. 4 under "E" of section 201 provides for effective cooperation between the National Aeronautics and Space Administration, Department of Defense, and so on, and then finally winding up with 5, resolve differences arising in departments and agencies of the United States with respect to aeronautical and space activities under this act including differences as to whether a particular project is an aeronautical or a space activity.

Now as I understand it, there has been no case of a referral to this agency for a settlement.

Mr. JOHNSON. That is right.

Mr. SISK. At any time.

Mr. JOHNSON. It has not been necessary.

Mr. SISK. And such differences of agreement as there have been have been settled between you and Dr. Glennan or——

Mr. JOHNSON. Other people in the DOD and myself, or Dr. Glennan and his associates, at that level, that is correct.

Mr. SISK. And at the present time there is no pending controversy. You feel you have a clear-cut operation under ARPA and that Dr. Glennan's field is pretty clear cut?

Mr. JOHNSON. No, sir, I would not say that. I would say this is too fluid a situation to say that now we both have clean-cut responsibilities and that they will be concrete a year hence. I think this is

a condition that will be very fluid. We will have to have many conferences on the kind of work we do and the kind of work they do, so that there is no duplication and there may be situations in the future when we would have to go to the Council for settlement. Up to now this has not been true, but I do not think that you can ever have a clean-cut line separating a civilian program and a military program.

Mr. SISK. Now, Dr. York, in your position, of course, you certainly are concerned about coordination and cooperation in the space field. Do you agree generally with the statements of Mr. Johnson that there seemingly is a cordiality of operation?

Dr. YORK. Yes, sir, I do. I was, of course, very closely involved with it when I was in ARPA.

Mr. SISK. Now, Mr. Chairman, if I could ask: Are these gentlemen appearing before us in executive session?

The CHAIRMAN. When we finish today we will adjourn until tomorrow morning at 10 o'clock. We will then proceed to make the rounds on the committee, everybody will have a chance to ask questions.

After that we will go into executive session.

Mr. SISK. I have some further questioning but I think that it would be advisable, because it has to do with some specific programs that I am particularly concerned about, to have it in executive session.

The CHAIRMAN. Are you through with questioning?

Mr. SISK. Yes.

The CHAIRMAN. Since you have mentioned that, I would like to take up one thing here in the open committee because some members are getting away. We find in the office of this committee that we are just crowded to death with carpenters and painters and everything is in a turmoil. I do not see how the people down there are able to work at all. As a result of it, we are just pushed in extremis to find more space. I have an offer here from the Congressional Hotel to lease us four rooms, a suite of four rooms for the purpose of a part of the staff being placed over there. I just wanted to tell the committee that we are entertaining that idea, that we will go over there and get at least four rooms in a suite, and this suite would cost us an annual rental of $6,000 per year. They will be known as 611. There are about 337 square feet including the kitchen but not including the large closet. There is one additional room, on a lease basis it would cost $2,700 per year. I mention this so the committee will know what you are up against and know that the staff is working under tremendous handicaps at the present time.

I just suggest to the staff that they undertake the bare essentials of the committee work and in the meantime I know the members of the committee will not expect them to be able to respond with alacrity to individual calls.

Mr. FULTON. Will the Chairman yield?

The CHAIRMAN. I yield to Mr. Fulton.

Mr. FULTON. I believe that if the Speaker cannot give us further space in Government buildings on the Hill that the chairman should then be empowered to go ahead and lease it.

The CHAIRMAN. I do not believe it takes any special action on the part of the committee here at this time. I do want the committee to know of the situation and I propose to go see the Speaker and if there is no available Government space, to proceed with the lease.

Mr. McDONOUGH. Does this mean the Space Committee is running out of space?

The CHAIRMAN. The Space Committee is running short of space. That being the case, Mr. Sisk, have you finished?

Mr. SISK. I have finished questions.

The CHAIRMAN. Mr. McDonough.

Mr. McDONOUGH. No questions, Mr. Chairman.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Mr. Chairman, in connection with the space offer at the Congressional Hotel, you know that you will not have a large closet, I do not believe the committee has any skeletons we need a large closet for. I would like to direct a couple of questions as to the Nike-Zeus system, Dr. York.

Are you satisfied with the progress in the development of this system?

Dr. YORK. Well, in the sense that I wish it were much further along than it is, no, but I am afraid the trouble rests with the facts of nature.

Mr. MITCHELL. Well, is it proceeding according to schedule?

Dr. YORK. It is moving forward and we are accelerating it. It is not so far along that you can make very useful judgment as to whether it is proceeding on schedule. The major milestones have not—we simply have not come to what I would regard as major milestones in this program yet.

Mr. MITCHELL. Doctor, do you have confidence in this system? Do you have hopes that someday this will be an operational weapons system?

Dr. YORK. I have hopes that it will be.

Mr. MITCHELL. Hopes and confidence are two different things.

Dr. YORK. It just is not far enough along to be certain.

Mr. MITCHELL. Now, if the question of money were out of the picture, if the money was there, do you have sufficient hope or belief in this system that you would today—no qeustion of money being involved or having to allocate it to other programs—do you have sufficient hope or confidence in it that you would order it into production today?

Dr. YORK. I do not believe that I would, because I know that premature ordering to go into production on something like this interferes with the necessary orderly development program.

Mr. MITCHELL. Would an explanation or elaboration on that require going into classified material, Doctor?

Dr. YORK. I am sure I could make better sense, I am not sure how good it would be even then, but I could make better sense out of my explanation in executive session.

The CHAIRMAN. Let us let it go until tomorrow.

Mr. MITCHELL. Very well; no further questions.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. No questions.

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Mr. Johnson, when the Medaris-von Braun request came to you yesterday, do I gather from what you said in answer to the chairman's question, that the inevitable answer to that request must be in the negative?

Mr. JOHNSON. Oh, no, sir, I did not mean to imply that at all.

Mr. QUIGLEY. I kind of got the impression, perhaps incorrectly, from what you said that even if you were to give a positive answer the moneys just would not be available in fiscal 1959.

Mr. JOHNSON. No, sir, I am sorry. Let me get my tabulation out here. I thought I made it clear that we had decided to fund everything that was requested in 1959. I will go back to the arithmetic. The program that I worked out with Medaris and von Braun in August, to proceed with the cluster, had as the base program $23 million in 1959, and $40 million for 1960. Now the thing that they came up with to go ahead with the launch complex at Canaveral and to give us lead time money, totaled $10 million. This I have agreed to. So I have brought that up now from $23 to $34 million which is everything that we can do in 1959.

Mr. QUIGLEY. In other words, out of the $40 million requested for 1960, you are already willing to say today that you will anticipate $10 million of that?

Mr. JOHNSON. Well, what I am doing now is identical in my 1960 budget, the $40 million, I had $6 million for this launch. I subtract that from my $40 million. I had the $3.4 million of long leadtime in my 1960 money, so I subtract that from the 40, but I am ready to add $15,600,000 in the 1960 figure to bring that up to $46 million, so I am ready now to say that we will have $34 million in 1959, $46 million in 1960, or a total of $80 million as opposed to the $63 million that we agreed to in August.

Mr. QUIGLEY. All right, now as to the request that you received as of yesterday, how much have they requested to be anticipated in fiscal 1959 which you have not yet made a decision upon?

Mr. JOHNSON. Well, let us see now. What they are recommending is that we go ahead with 16 vehicles, just say right now we are going to build an inventory of 16 vehicles and then have the long leadtime money that is required, incremental funding. I am not ready yet to say that we need or want 16 vehicles in the time we are talking about. We agreed we would order four. I can see the need for eight. But I cannot see the need yet for the other eight. We are evaluating now that this capability has been revealed to us. We are evaluating how we would use the additional vehicles in our forward-looking program at an earlier date. The incremental funding there would be another $5 million only and this decision yet has not been made for 1959.

Mr. QUIGLEY. Whether the number eventually turned out to be 4 or 8 or 16, you are already going to give the go-ahead sign on the launching pad?

Mr. JOHNSON. Oh, yes.

Mr. QUIGLEY. So any leadtime we needed in the construction would not be lost.

Mr. JOHNSON. That is right. We will have that launch facility ready ahead of the firing capability.

Mr. QUIGLEY. And the pending matter before you, as of yesterday, is whether you go ahead and give the go-ahead on the 16?

Mr. JOHNSON. On more vehicles and also the upper stages—are we getting close to classified material now—yes, I think we are.

Mr. QUIGLEY. That is all.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Mr. Chairman, gentlemen, I have been fascinated by one idea here for over a year and a half, and I suppose this possibly will be classified material, but I wish it would not be so that the American people could have the same answer I always get. We were off 4 years on our intelligence estimates as to when the Russians would have their first hydrogen bomb. I think you will agree this was true. We were off a considerable period of time as to when the Russians would launch their first space satellite. Further, we failed to estimate exactly the significance that this space satellite would have in the world. Now as a group of scientists, I am very curious to know how you equate the intelligence material you receive, from the light of our lack of ability to have accurate intelligence material, and come up with such things as we are behind them 4 years and all that. I wish you could expound on this in a public session.

Dr. YORK. It is not easy to talk much about intelligence matters in a public session, but it is not correct that we underestimated the time when they would have a satellite. They said they would have it in the IGY. They did have it in the IGY, and we believed in advance that they would have it in the IGY. You may be taking public guesses about what they will be doing rather than official information from CIA when you say that our intelligence has made these large misses. With regard to the hydrogen bomb, I am simply not sure whether we failed to anticipate it by 4 years or not. That is something that would have to be checked up on, and, furthermore, I think the precise information would be classified if we did have it.

Mr. WOLF. Then, Dr. York, would it not be better if we did not tell the people anything rather than to tell them a falsehood? That is what this appears to be.

Dr. YORK. Yes, but it was not one of us that told them. There is no way for us to stop amateur experts from getting up all over the United States and making their guesses and having them turn out to be wrong and that is the source of a very large fraction of this kind of information. It is not official information from CIA or from DOD at all.

Mr. WOLF. You feel, then, that you can equate pretty accurately what the Intelligence Service brings you?

Dr. YORK. I would hesitate to put a measure on that. I feel that we are doing fairly well along that line.

Mr. WOLF. Well, there was an article in Newsweek this past week. We American people who do not have this inside information have to look to the news services. We may be misled by what we read.

Dr. YORK. Yes; but we have no control over what Newsweek says, either us or CIA.

Mr. WOLF. Would it not be good for a statement to come from the Department, then, clarifying this?

Dr. YORK. That is a difficult question, sir. The fact that people who are not in official positions choose to make a guess at some fact should not be used by the Department of Defense or executive agencies as a reason for revealing classified information. I am afraid that at least in an official way if somebody came along and said that our hydrogen bombs are designed so and so and I knew it was false, it would not be up to me to say no, this is how it is.

Mr. WOLF. Well, I can see we are not getting very far on this line of questioning. I would like to ask one other.

Is there any basic research being done on some other weapon to do somewhat the same work as the ICBM?

Dr. YORK. I may be having a little difficulty here, sir, with the question of what is meant by basic research. However, we are certainly doing research and development on many alternatives to the ICBM. The Polaris, for example, is an alternative to the ICBM. The B–70 bomber is an alternate to the ICBM. The Weapons System 125A is an alternative to the ICBM, and then, of course, there are other means than nuclear weapons for waging war also, so I guess the answer is yes, we are doing a great deal in the way of working on alternatives to the ICBM.

Mr. WOLF. In the field of this long distance problem. That is what I was really referring to.

Dr. YORK. Yes, of course, the Polaris and long-distance airplanes carry weapons systems which compete with and are alternative to the ICBM.

Mr. WOLF. For some reason, possibly because I happen to be the father of three little children, I am still a little fearful from some of the testimony given here this morning. This question of our only defense being deterrent during this period of 1962, 1963, 1964—you say that our defense is deterrent, and yet we have had testimony here which demonstrates that the strategic bomber probably couldn't get through in sufficient numbers as a deterrent weapon.

Mr. YORK. I don't know who said it couldn't get through in such numbers. I believe the analysis of the experts in the Department of Defense and the Strategic Air Command is that it could get through in sufficient numbers.

Mr. WOLF. Thank you.

The CHAIRMAN. Mr. Karth.

Mr. KARTH. Mr. Chairman, following that last question, I would like to ask Dr. York whether or not the statement made some sense to him. You are a little skeptical, I think, as to whether the ICBM's make intercontinental bombers obsolete. Now, I think we can assume with a fair degree of accuracy or validity that both we and the Russians have good defense against the bombers. I don't think there is any question about that. We have been developing them for years. However, on the other hand, we have absolutely no defense against the ICBM's, and I just wonder if it makes sense to you, from that observation or other conclusion, that the bomber is fairly obsolete as a deterrent weapon.

Dr. YORK. Well, it certainly isn't obsolete today. I know that the military planners regard it as still being an important part of our arsenal in the middle 60's and beyond. I would hesitate to question their expertness on this matter of what it takes to make up a proper strategic force.

The bomber has a kind of flexibility the missile doesn't have and will retain a kind of flexibility the missile doesn't have for some time.

A bomber, for example, has a man in it; it can be called back; you can change your mind on what to do.

Once a missile has left the ground, it is gone, and if you have made a mistake and fired it when you shouldn't have, this is a fairly serious mistake to have made.

Mr. KARTH. Well, the same mistake is made if you drop the bomb from an intercontinental bomber.

Dr. YORK. That is correct, if he got all of the way to the target and did that.

Mr. KARTH. It wouldn't make much difference which mistake you made.

Dr. YORK. There is a difference, sir, in that the missle is at a fixed place on the ground. When you get, so to speak, a yellow alert, you can have the bomber take off and proceed part way. On a yellow alert there is nothing you can do with the missile except still leave it in the hole. You have to wait until the order comes to actually fire, and then fire and then it is gone, whereas the bomber is something with which you can reach at an intermediate point.

Mr. KARTH. I guess it is the judgment of people like you and those in the military that they would not put up a bomber or fire an ICBM unless they felt that this vehicle must get to the target in a substantially short period of time.

Let me ask you one other question, Doctor: Psychologically, I think the world recognizes that Russia is ahead in this whole field, primarily because they were the first to put a satellite in orbit and, secondly, because they have been able to lift such heavy payloads into orbit. This leads me to another question, and I think that this question, of course, will be answered by posterity. Certainly in the near future it is going to be answered one way or another, and we will be able to determine who was right and who was wrong.

It is my firm conviction if we are second on the moon, that this is going to have another tremendous psychological effect on people all over the world.

My question is this, sir: With what we have today, including all of the necessary items in the budget for advanced research, and so forth, and so on, do you think the manner in which we are proceeding today is going to put us first on the moon, that is, first before Russia?

Mr. JOHNSON. May I answer that question?

Mr. KARTH. Yes, sir; anyone who wants to answer it.

Mr. JOHNSON. The Department of Defense does not have a military objective to land on the moon, and I think the question should be more properly directed to Dr. Glennan. This is not in the ARPA or in the DOD program.

Mr. KARTH. Well, why don't you give me your opinion, then, inasmuch as it is not really in your field?

Do you have an opinion on it?

Mr. JOHNSON. I would prefer not to express an opinion. I think this would be improper because it is in another field, outside the Department of Defense.

Mr. KARTH. I yield to the gentleman from Iowa, who wishes to proceed.

Mr. WOLF. I would like to ask this question: Would you agree that psychological warfare is a part of the Department of Defense?

Mr. JOHNSON. No; I don't think the Department of Defense is charged with the direct responsibility for psychological warfare. This is determined by agencies outside of the DOD.

Mr. KARTH. Don't you think the result of this cold war is extremely valuable from the standpoint of the security of the United States of America?

Mr. JOHNSON. Oh, yes; I agree with that.

Mr. KARTH. And do you agree, sir, if the Russians were first on the moon, this would have a tremendous psychological effect on people all over the world?

Mr. JOHNSON. Unquestionably, yes.

Mr. KARTH. Thank you very much, sir.

The CHAIRMAN. Mr. Daddario.

Mr. KARTH. Let me ask one more question, Mr. Chairman, of Dr. York.

The CHAIRMAN. Excuse me.

Mr. KARTH. I believe you did say the request received from General Medaris—and I may be wrong on this—the request received from the general and Dr. von Braun was in two parts. One part dealt with the launching pad which you saw fit to go ahead with, and the other dealt with additional funds for upper stages, and it seemed to me you said that the second part of the request you had not yet decided upon; you would try to do so in a matter of a week or two, but that if you did decide to go ahead, you could do nothing about it in fiscal 1959.

Now, was I incorrect when I understood you to say that, sir?

Mr. JOHNSON. Well, no; what I meant to say is that he couldn't do anything about it in 1959.

Mr. KARTH. Who couldn't?

Mr. JOHNSON. General Medaris, that is, the agency at Huntsville.

Mr. KARTH. I see.

All right, thank you. That is all I have.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Dr. York, this morning Mr. Holaday referred to the fact that you have about completed the development stage of the Thor and the Jupiter.

In your statement you refer to the fact that one of your duties is to avoid duplicating procedures and programs.

Now, since the Thor and Jupiter have the same capacity to do the same thing, and since you have to take into consideration the moneys involved in duplicating programs of teaching crews and missions and logistical features of it, like spare parts, is this not a duplicating problem, a duplicating program which should be dispensed with? Should there not be a choice as between one and the other?

Dr. YORK. Sir, my directive contains the words "unnecessary duplication" rather than just eliminate duplication.

At the time that these two programs were started, it was decided by the people then responsible that both programs should proceed largely as a matter of insurance, because we were at that time taking a very large step from the Redstone, which has a range of a couple of hundred miles, on up into these 1,500-mile and 5,500-mile missiles.

There were differences between them. There were differences in the approach of the people, the engineers involved. There were differences in detail. They do have essentially the same performance characteristics, and they do have essentially—it has turned out that they have the same reliability.

In hindsight, it is correct that we could have gotten along with only one, but having come this far down the road, and having the development programs essentially finished, and these have moved into production, both procurement setups are available, and there is no particular saving at this point in making that decision. Had we, 4 years ago,

known what we know today, we would have saved a great deal of money by having picked just one.

Mr. DADDARIO. You mean, then, Doctor, that even despite the feature of safety in going through with both programs, when we have finally reached this stage, it is no more costly to have such a duplicating program and it is not costing this country more to have this duplication feature of logistics alone? That is always expensive. It is always more expensive to have two rather than one.

Dr. YORK. I would like to ask Mr. Holaday to answer that question, if I might, sir, because he has been involved in this problem much longer than I have.

Mr. DADDARIO. That will be fine with me.

Mr. HOLADAY. In proceeding with both of these missile systems, you will recall that the Secretary's information, as given to us last year, was that we had to proceed with both of them because of the urgency of deploying them at the earliest possible date. At that time we did not have proof that either missile system was going to be satisfactory. Since that date, during this past year, both of these missile systems have proven out, but we have to have 18 to 24 months' leadtime on a system of this type, and that is the reason we put them into production last year. We put both of them into production, and in doing this, we have been able to meet our deployment date.

Now, it is true, as Dr. York pointed out, having the information we have today, we should have started only one, 4 years ago. But we didn't have that confidence or know-how or ability to judge that one system would work, so we put both of them into production, and it is true the logistics will be higher, but we have gained time on the dates of deployment of these missiles.

Mr. DADDARIO. Well, I go along with that, Mr. Holaday, and it all makes sense that at the time we were uncertain and I am sure therefore we should have continued. I will go along as far as the point that it has helped us reach a schedule. But where is the point that we do become economical when we have met the schedule, once the danger is behind us, once the job has been done? Why can't we somewhere along the line say, "Now we cut out the one because the danger is behind us"?

Mr. HOLADAY. Well, we have met our objective, sir, both of them have been discontinued in production.

Dr. YORK. Both of them.

Mr. DADDARIO. I am sorry, I didn't get that.

Mr. HOLADAY. We have met our objective. Both of them have been discontinued. We have ordered our last one of both the Thor and Jupiter into production.

Mr. DADDARIO. That is all I have, Mr. Chairman.

The CHAIRMAN. Mr. King.

Mr. KING. I have a question or two which I shall address to whomsoever of the three distinguished witnesses cares to handle it.

Over the past 3 weeks or so we have had the privilege of hearing many, perhaps most, of the top men in this field. We find certain themes constantly recurring, certain areas of weakness, as I interpret it. One of them is this matter of correlating and collating and gathering and analyzing the technical information that comes from Russia and translating it, first of all.

We have been told on more than one occasion, for example, that the United States has done a very poor job of translating the Russian material, technical material that comes to us, in sharp contrast with the superb job that the Russians apparently are doing of translating our technical material that comes to them.

I remember that Dr. Mumford, over at the Library of Congress pointed out that we had the largest Slavic library, outside of Soviet Russia, in the world, so apparently we have lots of material. But it seems almost outrageous or at least grossly negligent that we should have allowed all of that technical information to come and not to have put it to maximum use.

So my question is:

Do you feel that comment is justified, and then do you think that steps are now being taken to adequately translate and to use this information that comes in to us?

Dr. YORK. Well, there is a disparity, there is a difference between their treatment of our information and our treatment of their information. Quite a bit is being done to translate and correlate a great deal of effort. Our organization is ASTIA, the Armed Services Technical Information Agency, which is following the work in this respect. Nevertheless, the Russians have one leg up on us, no matter what we do; that is, virtually all Russian scientists read English well. Until American scientists read Russian well, all of the technical aids will not make us equal with respect to this particular problem.

Mr. KING. I understand.

That would seem to suggest a greater emphasis on languages, particularly Russian, at the graduate school and high school level?

Dr. YORK. Much greater emphasis on languages, yes.

Mr. KING. May I ask another question now?

Reference has already been made today to the matter of leadtime.

As I understand it, Stanford University conducted a research project on this. I have not read this. I am relying on hearsay. But I understand that the results of that research demonstrated that the leadtime in Russia was considerably less than our leadtime, and further subdividing that leadtime into the time it takes to make decisions, the time for R. & D., and then the time for actual production, I believe this research pointed out that in production we are actually faster than the Russians; in R. & D. we are about the same, but where we lose so much ground is in the matter of decision, and because of that, the total leadtime for us is considerably more, and that in turn suggests perhaps a lot of administrative redtape is very disastrous.

Would you like to comment on that?

Dr. YORK. Well, in the first place, our Thor and Jupiter programs were done in a shorter time—there are some figures that have been brought up in connection with these things, as to how long it takes us and how long it takes them.

In general, the figures that are quoted indicate that it takes the Russians less time than it takes us to go from initiation to final device. However, I believe that the Thor and the Jupiter actually are cases where it took us less time than our critics say it takes the Russians, and in the Atlas and Titan, the time will be about the same as what they are usually credited with.

There are a certain number of delays, and so forth. I am not as familiar with this subject as I should be. I am aware of the report you are speaking of. It is one of a number of things in a stack which says for the new Director to read, and I will get around to it, I hope, soon.

I think that if we look into it further, some of the reasons that it takes longer to make a decision is because the requirements on the decision or what the decision should contain have to be better. We are required, for example, to hold competitive bids and to review these and to review them carefully to see who should get the job. This is part of the decision-making process in this country, which is not required at all in the Soviet Union.

So a great many of the delays in decision, I am sure, without being a true student of it, have to do simply with the difference in systems, both political and economic, and the requirements that these differences place on what the decision contains and what is to be considered in making the decision, rather than on the question of how many people are involved in making the decision and how hard they are working at it.

Mr. FULTON. And after the Department of Defense gets the money through the apportionment hearings of the Bureau of the Budget, they don't know what projects it will be spent on; is that right?

Did the witness say "Yes" or "No" or anything?

The CHAIRMAN. I didn't hear the witness say anything.

Dr. YORK. I am speechless.

The CHAIRMAN. Mr. King.

Mr. KING. Just one other short one.

Would you agree with the statement, that we have heard many times before, that one of our basic weaknesses is in the area of basic research as opposed to supporting research? It is basic research that is needed to develop a scientific program, and of course with that, the idea of greater emphasis on scientific education, tough courses down in the grammar school, and high school levels of our education?

Dr. YORK. Sir, I believe the consensus is we are at the present time ahead of the Russians in basic research, but they are coming up fast. It is evident that we could do more basic research than we have done, and it is also evident to me and most of my colleagues that we should and we do intend to augment the level of basic research in the DOD.

Mr. KING. Thank you.

The CHAIRMAN. I would like to ask you a question or two.

In reference to the matter touched upon by Mr. King, that is, in translating from Russian to English; I know it probably doesn't come within the jurisdiction of the Defense Department, but don't you think if we had some definite program to make translations of key articles from Russian to English, that it would be of great benefit to all of our scientists?

Dr. YORK. We are supporting translating programs, sir. We are not the only Government agency that is involved, but we are supporting them, and I believe that we took the lead in initiating them.

The CHAIRMAN. How much money are you putting into it?

Dr. YORK. I really don't know. I could try to find out, but I really don't know.

The CHAIRMAN. Now, are you making available to the scientific projects, such as your team down at Redstone or at San Antonio or the Pacific coast, making available the translated Russian?

Dr. YORK. Yes, and of course they have other sources, too. There are translations made by groups outside the Department of Defense. There are even, in some cases, translations made by private agencies, and translated journals are available on the market.

The CHAIRMAN. I don't think there should be duplication. That is one field where you can check duplication.

Dr. YORK. Yes.

The CHAIRMAN. You can eliminate the duplication and perhaps bring about translation of more articles.

I recently talked with a scientist who is with a great university in this country, and he had been to Russia, spent several months there, and gone to the republics away from Moscow, and Leningrad, and he was impressed with the freedom with which they would talk to him about what they are doing over there.

Now, if that freedom finds its expression in articles that they publish, and I am sure a great many of them are published, we should certainly take advantage of that possibility.

Do you know whether that is being pursued as vigorously as you think it should be?

Dr. YORK. I really don't know that it is being pursued vigorously enough. But it is being pursued.

The CHAIRMAN. Well, there is no reason why we shouldn't read the articles if they are there, and we shouldn't be ashamed of that.

Dr. YORK. No, sir, I don't think we should be. There are some cases where it is hard to get the rarer and more obscure journals. The principal Soviet journals, though, are easily available in this country.

The CHAIRMAN. I am wondering this: We have nobody on our committee staff who reads Russian, but—I am mistaken. We do have one man reading Russian, but I doubt that he could read as freely in Russian as he can in English, and if the staff has available those translated articles, it might be of assistance to us here, too. I want to ask you this:

In your statement, Doctor, you referred to 180 R. & D. facility-type items totaling close to $200 million.

Now, they would come within the jurisdiction of this committee, and so to get an idea of the jurisdiction of the committee, could you give us a list for insertion in the record of those projects?

If they are classified, of course, don't put them in the record, but you can refer to them as classified and work it out in such a way that you would be fully protected.

Likewise, a breakdown on the expenditures. You have set forth on page 5 of your statement, and you show, for instance, for the fiscal year 1959, which is the current year, $3.4 billion obligational authority. If you could break that down in some way, so that our staff could analyze just where the money is going, it would help us in the jurisdictional matter.

Dr. YORK. If it is of any help, the table immediately below that does break down the fiscal 1960 amounts into eight categories.

The CHAIRMAN. Could you break them down for 1959, also?

Dr. YORK. Oh, yes, sir.

(The requested information is as follows:)

LIST OF RESEARCH AND ENGINEERING SUPPORTING FACILITIES CONTAINED IN THE PROPOSED FISCAL YEAR 1960 MILITARY CONSTRUCTION AUTHORIZATION PROGRAM ON WHICH RECOMMENDATIONS WERE MADE BY THE OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

DEPARTMENT OF THE ARMY

Redstone Arsenal, Ala.:
- Extend and strengthen runway.
- Airfield lighting.
- Modify line 6 for rocket motor casting.
- Conversion of building 112 to hospital.
- Bachelor officers quarters.
- Expansion of utilities, electrical, steam, roads.

Fort Detrick, Md.:
- Four animal breeding buildings.

Dugway Proving Ground, Utah:
- Communications building.
- Photo-optometric instrumentation laboratory.
- Water storage tank.

Fort Huachuca, Ariz.:
- Trainfire I range.
- Hardstand, aircraft (Libby AAF).
- Ground telemetry station.
- Ten test communications buildings.
- Radar test building.
- Electronics instrumentation building.
- Avionics laboratory and instrumentation building.
- Countermeasure instrumentation center.
- Drone test facility.

Fort Belvoir, Va.:
- Extension of runway (DAAF).
- Modification to building 318.
- Modification to center section, building 327.

Surface-to-air missile tactical facilities (inside the United States): Missile master and electronic facilities.

Surface-to-air missile tactical facilities (inside and outside the United States): Various research and development technical and support facilities (classified).

DEPARTMENT OF THE NAVY

David Taylor Model Basin, Md.:
- Expansion of acoustic analysis center

Naval Air Station, N.J.:
- Electric substation and distribution improvements

Naval Air Station, Md.:
- Seaplane fueling stations
- Arresting gear test facility

Naval Air Material Center, Pa.:
- Catapult and arrest component research facilities

Pacific Missile Range, Calif.:
- Point Mugu:
  - Aircraft parking apron
  - Fuel storage facilities
  - Meteorology building
  - Automotive maintenance facility
  - Frequency control facility
  - Mobile instrumentation stations
  - Instrumentation facilities (Pt. Pillar)
  - Photographic installation and calibration facility
  - Missile project building
  - Armaments test project building
  - Addition to instrumentation building
  - Warehouse
  - Addition to dispensary
  - Pacific missile range headquarters building

DEPARTMENT OF THE NAVY—continued

Pacific Missile Range, Calif.—Continued
Point Mugu—Continued
Addition to security building
Barracks
Addition to mess hall
Addition to bachelor officers' quarters
Structural fire station
Chapel
Expansion of roads and utilities
Standby gas plant
Expansion of water system
Point Arguello:
Public works shops
Radio receiver facility (2d increment)
Central launch control facility
Missile assembly building
Operational computer center real time
Ordnance assembly building
Launch site support building
Range users engineering building
High explosive magazines
Multipurpose marine detachment building
Fire station
Roads and utilities
Launch site security facilities
San Nicolas Island:
Expansion of telephone exchange
Photographic building
Electronic maintenance shop
Pacific Ocean MILS Facilities:
Additions to communications buildings (Eniwetok Island)
Additions to communication buildings (MCAS Kaneohe Bay, Oahu Island)
Addition to communication building (Wake Island)
Missile impact location building (Eniwetok Island)
Missile impact location building (MCAS Kaneohe Bay, Oahu Island)
Missile impact location building (Midway Island)
Sounding rocket facility (Eniwetok Island)
Bachelor civilian quarters (Wake Island)
Naval Air Turbine Test Station, N.J.:
Acquisition of land
Naval Propellant plant, Md.:
Explosive ordnance technical facilities
Polaris facilities, various locations:
Classified facilities
Naval Medical Research Laboratory, Conn.:
Medical research laboratory (2d increment)
Naval Radio Research Station, W.Va.:
Maintenance shops
Dispensary
Administration building
Family housing—Capehart
Barracks
Marine barracks
Mess hall
Bachelor officers' quarters w/mess
Fire station
Navy-Exchange commissary
Warehouse
Recreational building
Utilities and site improvement
Naval Research Laboratory, D.C.:
High level radiation laboratory

Antigua Test Site:
Guided missile data collection and radar station
Arnold Engineering Development Center, Tenn.:
Gas dynamics test facility (addition)
Propulsion wind tunnel duct (modification)
Propulsion engine test cell (modification)
Propulsion engine test stand (modification)
Switching station (modification)
Cape Canaveral, Fla.:
Guided missile data collection radar station
Edwards Air Force Base, Calif.:
Electronics laboratory, calibration
Guided missile test shop components
Outpatient facility (addition)
Eglin Air Force Base, Fla.:
Guided missile shelter
Test stand, jet
Guided missile data collection theodolite station
Holloman Air Force Base, N. Mex.:
Equipment laboratory parachute test (addition)
Guided missile laboratory instrumentation
Water distribution mains
L. G. Hanscom Field, Mass.:
Library, research and professional
Electronic laboratory, solid physics
Science laboratory, data collection
Administration office
Patrick Air Force Base, Fla.:
Electronic test shop systems (addition)
Sacramento Peak, N. Mex.:
Science laboratory, solar observatory
Emergency electric powerplant
Road
Wideawake Field, Ascension Island:
Guided missile data collection equipment station
Wright-Patterson Air Force Base, Ohio:
Aircraft laboratory fatigue test facility
Propulsion laboratory, components test (HEF)
Science laboratory, medical (nuclear environmental)
Spec laboratory analysis
Spec laboratory analysis

Department of Defense summary of research, development, test, and evaluation

[Millions of dollars]

	Fiscal year 1959	Fiscal year 1960
Military sciences	307.6	364.1
Aircraft and related equipment	450.5	497.3
Missiles and related equipment	1,252.8	1,410.8
Military astronautics and related equipment	340.4	309.1
Ships and small craft and related equipment	155.2	161.6
Ordnance, combat vehicles, and related equipment	195.7	229.0
Other equipment	551.6	441.0
Programwide management and support	210.2	209.3
Total	3,464.0	[1] 3,622.2

[1] Does not include $150 million emergency fund.

The CHAIRMAN. That will help us a great deal, and the staff would probably go over your statement and ask you for a further breakdown of some of these items.

Then you referred to, I think, just a few facilities here in your statement that are engaged in special type work. I don't have that before me here, but if there are other facilities you refer to, we would like to have a list of those, too.

Dr. YORK. I am not sure I understood the question.

The CHAIRMAN. I want the facilities you refer to.

Dr. YORK. The $200 million worth. That is page 4, which is 180 items, totaling close to $200 million.

The CHAIRMAN. Well, we simply want it broken down so that our staff can analyze it and see just what is going on, so that we can help keep up with the work that you are doing.

Dr. YORK. Yes.

The CHAIRMAN. That is not in a critical vein but to establish the jurisdiction of the committee and to facilitate the program legislatively.

I want to ask about the Vandenberg base on the Pacific coast.

I think you testified, at least someone did, in the Senate hearings about the progress made toward activating a squadron at the Vandenberg Air Force Base.

Do you have any information on that?

Mr. HOLADAY. What is your particular question?

The CHAIRMAN. I want to know what is being done, if anything, to further speed up the activation of that squadron at the Vandenberg base.

Mr. HOLADAY. A deployed squadron?

The CHAIRMAN. Yes.

Mr. HOLADAY. Sir, we are constructing facilities at Vandenberg Air Force Base for the deployment of one of the ICBM missiles. It is also——

The CHAIRMAN. Is that what is delaying it, the construction?

Mr. HOLADAY. Yes, sir.

The CHAIRMAN. So you can't deploy it until the construction is completed. Are you pushing that construction vigorously?

Mr. HOLADAY. Yes, sir; we are meeting the request of the Air Force. There is no shortage of money in that deployment plan there.

You also understand that we make experiments in the method of deployment at Vandenberg base. It is also a training facility. So they are not simply straightforward types of deployment. We may have several methods of deployment being used at Vandenberg because of tying them in with the training.

The CHAIRMAN. Is that the reason it is being delayed?

Mr. HOLADAY. It is not being delayed, sir.

The CHAIRMAN. Perhaps I worded my question wrongly. The Senate hearings indicated that by July 1 you would have some deployed, but, as I recall, it would probably be a year before you had a full squadron deployed.

Mr. HOLADAY. I would not like in this particular meeting to say what exactly we have deployed or the exact dates. I would be glad to cover that tomorrow in an executive meeting.

The CHAIRMAN. I will ask you about it tomorrow, then.

I want to ask you another question, and then I will be through.

Is this million-and-a-half-pound-thrust rocket the type of missile that would be used in a lunar probe?

Dr. YORK. I would like to refer that to Mr. Johnson.

Mr. JOHNSON. I am sorry. Would you repeat the question?

The CHAIRMAN. The million-and-a-half-pound-thrust missile that you are working on, by clustering the engines together, is that the type of missile that might be used in a lunar probe?

Mr. JOHNSON. Yes, sir; it is one. There are a number of vehicles that could be used. This is certainly one; yes.

The CHAIRMAN. Would it be suspectible to use in the Sentinel program?

Mr. JOHNSON. The Sentry?

The CHAIRMAN. Is it Sentinel or Sentry?

Mr. JOHNSON. Sentry.

Yes; certainly it will be used in all military and some civilian programs.

The CHAIRMAN. Is there any justification for speeding up the million-pound-thrust missile?

Mr. JOHNSON. I think that is going as fast as it can go. This is a long, hard job to develop a practical thrust of that size.

The CHAIRMAN. Do you have any information on the Russian missile, indicating the thrust and the technical way in which it was built?

Mr. JOHNSON. We can guess that the thrust that the Russian missile has developed is something around 500,000 pounds of thrust.

The CHAIRMAN. And we are developing a million and a half pounds, so it would be three times the power of the Russians?

Mr. JOHNSON. I am sorry, sir. This gets kind of technical, because you have to take into consideration upper stages, and I am talking about the basic thrust, the basic booster.

Now, we do know or we do think that the Russians have clustered engines, as we are planning to do, and do have upper stages as well, so I am talking about the basic booster. Our guess is that we may be passing them or equaling them at least, and probably passing them when we have our million-and-a-half-pound thrust ready.

The CHAIRMAN. You think the Russians are using clustered missiles?

Mr. JOHNSON. We have reason to guess this; yes. They may be clustering IRBM's. Anything more on this would be classified, I am afraid.

The CHAIRMAN. I will not pursue the question any further at this time.

Mr. Wolf, you had another question?

Mr. WOLF. Yes.

May I say that I am grateful that you came down today. If I seem to be critical, it is based on the very natural reaction every citizen in America has to what he reads in newspapers which discourages him as to where we stand.

Now, my next question is academic, as to a balanced budget and things of that kind.

One thing that depressed me at Cape Canaveral and at Huntsville was the fact that the minute the missile takes off, no matter what kind it is, it is gone. As we get into the Saturn program, this cluster program, where we have a battleship in effect taking off, I am wondering if there is any honest-to-goodness research being done to salvage these first and second stages so it won't be a complete waste the minute it is launched.

Mr. JOHNSON. Very definitely. This is something we have asked ABMA to develop, to recover the booster and the engines, and I think there is every reason to believe that this is feasible.

Mr. WOLF. Would you care to enlarge on what method of procurement or reprocurement could be used?

Mr. JOHNSON. No—well, we are getting classified now.

Mr. WOLF. Well, we will ask you that tomorrow then.

Mr. FULTON. I have a question, if I may, sir.

The CHAIRMAN. Mr. Fulton.

Mr. KARTH. I asked the gentleman to yield for a moment.

The CHAIRMAN. I promised to recognize Mr. Fulton next.

Mr. FULTON. I will be glad to yield.

The CHAIRMAN. Then we will recognize you, Mr. Karth.

Mr. KARTH. Mr. Chairman, just one question I had.

All the way through these written presentations I have noticed that they have laid a great deal of emphasis on the assignment of programs, and it seemed to me as I read along with the gentleman that "Mrs. V," which is under ARPA, and Dyna-Soar, which is under DOD, seemed to be similar. Is that correct?

Mr. JOHNSON. Yes.

First you must get a man in orbit to see if he can function, if he is useful in space. This is the object of the Mercury program.

Following this, in the military, we want to put a man who can maneuver in space. Dyna-Soar or "Mrs. V," which are really the same programs, would use the information obtained in Mercury, and then would go from there to develop a winged airplane which could orbit at the will of the pilot and land at a preselected base.

Mr. KARTH. Fine.

Thank you, sir. That is all.

The CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. Dr. York, I will submit a list of questions to you to be inserted along with the answers in the record.

(The questions and answers are as follows:)

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING,
Washington, D.C., March 9, 1959.

Hon. R. WALTER RIEHLMAN,
House of Representatives.

DEAR MR. RIEHLMAN: In response to your request of February 19, 1959, I am pleased to furnish the attached answers to the questions which you desire to be made a part of the hearings currently being conducted by the House Committee on Science and Astronautics. I believe the format used will lend itself to ready incorporation in the record of the hearings.

Sincerely yours,

HERBERT F. YORK.

Mr. RIEHLMAN. Does the authority of your Office extend to individual projects under the control of General Medaris in the Army, Admiral Raborn in the Navy, and General Schriever in the Air Force?

Dr. YORK. Yes, I have supervision over all research and engineering activities in the Department of Defense including the missile programs. However, this does not mean that I am concerned with the detail of the day-to-day administration of these programs; but I will, of course, become directly involved on major issues and any items involving controversy.

Mr. RIEHLMAN. Do you have authority to change or assign priorities among missile projects in the three services and ARPA?

Dr. YORK. Yes, with the exception of those missile projects which have been assigned a national priority by the President.

Mr. RIEHLMAN. Can you modify, cancel, suspend, or accelerate specific research and development projects in all agencies of the Department of Defense?

Dr. YORK. Yes, I can and will do so whenever such action is clearly indicated.

Mr. RIEHLMAN. Does your authority extend to contracting arrangements entered into by agencies and officies within the Department of Defense for the performance of technical support, systems engineering, feasibility studies, and other services connected with research and development functions? Specifically, such functions as those performed by Space Technology Laboratories and the Institute for Defense Analyses?

Dr. YORK. Yes, my authority covers all phases of the research and engineering activity in the Department of Defense. However, I would not become involved in the details of contract administration unless a specific problem arose which required such intervention. The detailed supervision of the specific contractors which you mention would be the responsibility of the Air Force for the work of the Space Technology Laboratories, the Director of WSEG and the Director of ARPA for the Institute for Defense Analyses.

Mr. RIEHLMAN. Does your Office have complete access to all records and technical data within the control of research and development contractors, including STL and IDA?

Dr. YORK. Yes, my Office will have complete access to any information which is derived in the performance of contracted work.

Mr. RIEHLMAN. What control does your Office exercise over funding for proposed and approved research and development projects in the Army, Navy, Air Force and ARPA?

Dr. YORK. I have the authority to approve, disapprove, or modify all proposed or existing DOD research and development programs and projects including the funding for such projects.

Mr. RIEHLMAN. How do the functions of WSEG relate to the functions of your Office?

Dr. YORK. I work very closely with the Joint Chiefs of Staff in making assignments to WSEG and assuring that such assignments are completed as expeditiously as possible. Every effort is made by my office to insure that the results of WSEG studies are incorporated into the research and engineering plans and programs of the military departments as soon as possible after evaluations have been completed and accepted.

Mr. RIEHLMAN. What are the relationships between WSEG and IDA? Between WSEG and ARPA?

Dr. YORK. The IDA contract was initially designed to provide needed technical competence which WSEG could not recruit or retain under normal administrative procedures. Assignments varied in nature and required such diverse talents that it became impracticable and uneconomical to depend upon a permanent staff for conducting the required studies. In fact, the natural tendency was to tailor the studies to the staff available rather than to determine the actual requirements and then obtain the personnel best qualified to conduct the evaluations.

This contractual arrangement worked so well for WSEG that a similar procedure was established with IDA when ARPA was organized. IDA established an Advanced Research Projects Division under the contract for the purpose of furnishing technical assistance to ARPA when needed. Other than this mutual contractual arrangement there is no direct relationship between ARPA and WSEG.

Mr. RIEHLMAN. Are the records and technical data under the control of IDA, ARPA and your Office, the Directorate of Defense Research and Engineering, completely available to WSEG?

Dr. YORK. Yes, WSEG has access to any information which is needed to complete their assignments.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. The moon is not outside of your strategic area of operations?

Dr. YORK. I wanted to correct the record here.

Dyna-Soar and "Mrs. V" are not the same program. Dynasoar is the name of an Air Force program which is best described as being the followup of the X–15 program, which is a hypersonic airplane. Dynasoar is not a space program.

Some of the people who participated in it, for one reason or another, like to boast that it is, but it is not. It is a proposal to develop hyperhypersonic airplanes, if you like, leading, perhaps eventually to a glide bomber.

The information gained from the Dyna-Soar program or the first phases of the Dyna-Soar program will be information which is necessary and essential in order to go on further with a recoverable maneuverable or I should say a maneuverable recoverable space vehicle, "Mrs. V", which Mr. Johnson was referring to.

They are supplementary programs. "Mrs. V" is in the study phase at the present time, I might comment and not in the active development phase in any event.

The CHAIRMAN. Are you going to use these space men in the Dyna-Soar program?

Dr. YORK. No, not in the parts of the Dyna-Soar program that are in sight, because it doesn't go into space. It may go up and come back after brief penetration——

The CHAIRMAN. It skips and hops into space?

Dr. YORK. Yes, like the X–15 does.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I am glad to have the explanation, although I do not feel that the record was actually contradictory. I think it was just a question of the changing use of terms. Obviously, there is no such thing up there as we term air in the atmosphere where the Dyna-soar will be operating, so that on some terminations you could call it space, atmosphere, but not air.

Dr. YORK. That is a reasonable way of looking at it.

Mr. FULTON. The question comes up. If the moon is within our strategic area as to a manned satellite, why wouldn't it be possible to put up an unmanned tank and direct it by radio from the earth or from a station?

Dr. YORK. From the standpoint of technical feasibility it would be possible to do that.

Mr. FULTON. Why wouldn't that be the next stage after a hard landing of some sort of instrument on the moon?

Dr. YORK. That very well may be.

Mr. FULTON. Yes, but what I am really asking you: Are you planning that it will be?

Dr. YORK. That is the NASA's responsibility, as presently understood by us, as to the exploration of the moon.

Mr. FULTON. So you would not then be in on the landing of an automatic tank of any kind on the moon, even though we did not have it manned?

Dr. YORK. Our understanding of the program is that that is in the NASA's responsibility.

Mr. FULTON. You see, I may be trying to get you some jurisdiction there.

Well, may I finish with this.

I do think you are all doing a good job, and I want to compliment Roy Johnson as well as Dr. York and Mr. Holaday for the excellent work they have done in this field, which is very difficult—where we cannot explain to the public fully just what is being done. May I ask this question:

You believe that this country is secure and that we have an adequate program of balanced forces of various kinds, including your area, where you can assure the public that we are not delaying, but moving ahead with all reasonable speed? Is that right?

I would like each of you to answer that.

Mr. HOLADAY. The answer to your question, in my own opinion, is "Yes." We would like to move ahead faster technically, but this is not a question of money to do it. It takes time. It takes education. It takes cooperative work to move ahead in these areas.

Overall, I believe that the country has a well-balanced program, using to the best of its ability its technical knowledge and applying this to weapons systems.

Mr. FULTON. Dr. York?

Dr. YORK. I also believe the program is reasonably well balanced; yes, sir.

Mr. FULTON. And that it is moving ahead now?

Dr. YORK. It is moving ahead adequately.

Mr. FULTON. For the security of the country?

Dr. YORK. In any field of interest, yes.

Mr. FULTON. Mr. Johnson?

Mr. JOHNSON. I could answer your question this way, I think:

I will admit when I came to Washington a year ago, I had doubts. I don't today. I am sleeping very comfortably.

Mr. FULTON. Thank you very much.

The CHAIRMAN. Let me say this:

That question is a Mother Hubbard question. It covers everything.

How can you feel like the program is moving ahead satisfactorily when it is going to take 3 or 4 years to overcome the Russians?

I am asking all three of you that, because there is a great responsibility falling on all of us, when we know the Russians are ahead. It is unusual that the Russians are ahead of us in military equipment. That is really what it is.

Mr. JOHNSTON. As I said earlier, they are ahead in space technology, but I don't believe this is any reason why I should not sleep comfortably. I do not think in the period we are talking about that space technology is going to be used militarily against us to the point that the country is in jeopardy.

The CHAIRMAN. What period do you think that will be in, beyond the next 3 or 4 years?

Mr. JOHNSON. I think we will have caught up with the Russians in that period of time, and then the time of danger comes out of there.

The CHAIRMAN. You mean we are safe for 3 or 4 years, and the time of our danger comes after that?

Mr. JOHNSON. Yes, and then we will have caught up with them. I think the question here was on balance, total effort, as to whether we felt we were doing a good job, and whether we were secure, and the answer to the question was on balance.

The CHAIRMAN. Let me say this in conclusion:

We have kept you gentlemen here a long time. You will be available tomorrow for executive session, will you not?

Dr. YORK. At the same time?

The CHAIRMAN. Yes, at the same time, 10 o'clock.

I want to say on behalf of the committee that we do appreciate your coming here, and I think you have answered the questions candidly and frankly and have been of great help to the committee.

This is the first time that we have had the opportunity of having you three distinguished gentlemen appear before us, and we appreciate that very much.

If there is no further business, then the committee will adjourn until tomorrow morning at 10 o'clock.

(Whereupon, at 12:55 p.m., the committee recessed, to reconvene at 10 a.m., Wednesday, February 18, 1959.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Wednesday, February 18, 1959.

The committee met at 10 a.m., in room 356, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order.

This morning we have as our first witness Dr. Abe Silverstein, director of Space Flight Development.

Dr. Silverstein, we are certainly pleased to have you here this morning on what I consider to be a most auspicious occasion. You are going to tell us a little bit about what has been going on at Cape Canaveral and what is going on up there 3,000 miles above this world.

Dr. SILVERSTEIN. Yes, Mr. Chairman. Let me say first I am very happy to be here, to be invited to talk to you folks about the satellite. Dr. Hagen is with me. I will make a few general remarks. I have a statement, and he will continue telling in a little more detail about the satellite and its flight.

Shall I read the statement?

The CHAIRMAN. Surely, if you will.

STATEMENT OF DR. ABE SILVERSTEIN, DIRECTOR, SPACE FLIGHT DEVELOPMENT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. SILVERSTEIN. As you know, we launched a 21½ pound Vanguard weather satellite yesterday morning. From all indications, it is transmitting valuable cloud cover data which can be related to the overall meteorology of the earth.

This is a very exciting historic experiment. It represents a first step toward obtaining continuous, 24-hour-a-day weather mapping of global scope. At the present time, by means of weather ships, balloons, and so forth, we are able to map only 10 percent of the world's weather, so it's not hard to see why we are excited about this experiment.

I would like to review, briefly, the history of Project Vanguard because I feel there has been considerable misunderstanding about this project from the very beginning. And at the outset, I'd like to pay tribute to Dr. John Peter Hagen, chief of NASA's Vanguard Division, whose faith in the Vanguard rocket, and the project in general, has never wavered.

On July 29, 1955, the White House announced that the United States planned to launch earth satellites as part of this country's contribution to the International Geophysical Year which ended formally on December 31, 1958. Project Vanguard was the name assigned to that part of the satellite program which was under management of the Chief of Naval Research, Adm. Rawson Bennett. The Naval Research Laboratory (NRL) in Washington, D.C., under the leadership of Capt. P. H. Horn, had responsibility for technical aspects of the program.

Here, I would like to emphasize a fact that is too often forgotten: The Navy set out to produce, essentially from scratch, a satellite launching vehicle in a remarkably short time. The very production of this vehicle was to be, in a sense, one of the most significant contributions of the IGY. The Vanguard vehicle is an advanced rocket, parts of which are in use in other U.S. rockets and missiles.

On October 1, 1958, the President by Executive Order 10783 transferred "all functions (including powers, duties, activities, and parts of functions) of the Department of Defense, or any officer or organizational entity of the Department of Defense with respect to * * * the U.S. scientific satellite project (Project Vanguard)" to the National Aeronautics and Space Administration.

Under authority of this Executive order, 133 members of the Vanguard group at the Naval Research Laboratory and 25 persons in other divisions of the Naval Research Laboratory devoting substantially full time to the Vanguard project, a total of 158 persons, were transferred to NASA on November 30. Of these, 86 are scientists, 42 technicians, and 30 administrative and support personnel. Project Vanguard developed not only the Vanguard vehicle but also the IGY radio tracking net (Minitrack) which has been used not only for Vanguard but for observation of every active satellite so far launched, United States and Russian. With the transfer, responsibility for this network passed to NASA.

At the time of transfer to NASA the engineering and manufacture of the vehicles was essentially completed. Seven three-stage vehicles, i.e., test vehicles TV–3, TV–3BU, TV–4, TV–5, and satellite launch vehicles SLV–1, SLV–2, SLV–3, had been launched. Modifications which resulted from study of records from each launching attempt were being incorporated in the remaining vehicles. Additional preflight operations intended to eliminate the causes of low performance of the second stage in previous flights, had been adopted and were being applied to SLV–4, which is the satellite launched yesterday. There remain four vehicles to be fired.

When responsibility for the Vanguard program was given to NASA, we reviewed the complete history of the project. The Vanguard vehicle is comparable in complexity and application of advanced techniques to military ballistic missiles. Its early flights experience is substantially the same as that of the other missiles, whose failures and successes were not made a matter of public record. The personnel of the Vanguard group are highly competent, and we are pleased that their services have been made available. They have joined in the overall activity of NASA with highly cooperative spirit and are active in the formulation of the national space program.

As a result of administrative review of Vanguard history, NASA decided to postpone the Vanguard firing scheduled for December 1958 to February 1959 to provide time for an objective technical review of the vehicle to determine whether any additional steps might be taken to increase the probability of success. A working committee composed of experts having no previous connection with Vanguard studied in detail the systems involved in the vehicle and vehicle launching. The committee examined all pertinent data from the Vanguard launchings and from the use of Vanguard components in other vehicles such as the Thor-Able reentry and moon-probe vehicles. Numerous modifications in the system and operational practices were made as a result of the work of the review teams and the Vanguard and industrial teams working together.

Whether any of these modifications definitely helped in achieving success of Vanguard II is difficult to say. Definitely the conservative engineering approach that led to a deliberate look by all the participants at their equipment and operating practices was correct in principle.

Prior to yesterday's successful experiment, one Vanguard satellite had achieved orbit—a 3¼-pound test sphere which was launched on May 17, 1958. Its 50-pound third stage rocket casing also went into orbit. Vanguard I, as it was christened, is still aloft, with an expected lifetime of hundreds of years. Its solar batteries are still doing their job and the Army Map Service has been making electronic observations of the satellite from Pacific islands to pinpoint their location more exactly. The satellite is also being used for more exact determination of the earth's shape.

The Vanguard II cloud cover satellite is the first in a series of meteorological satellites to be launched by NASA during the next few years. These satellites should gain information about the weather and how it develops. Substantial economic returns—to say nothing of returns in the form of lives saved by accurate forecasting of hurricanes, typhoons, etc.—can be expected as the technology is developed.

Before closing, I would like to note the contributions of the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J., which developed the instrumentation in the cloud cover satellite; also, the contributions of the industrial firms which have been associated with Project Vanguard under the Martin Co. as prime contractor. The General Electric Co. provided the first-stage rocket. The Aerojet General Corp. provided the rocket for the second-stage booster, and the Grand Central Rocket Co. made the third-stage rocket. The guidance and control equipment was developed from contributions by the Minneapolis-Honeywell Regulator Co., Designers for Industry, Air Associates, and the Martin Co. The fine contributions of these industrial teams are representative of the high level of the Nation's industrial technology and lead us to a feeling of confidence in the future of our programs.

The CHAIRMAN. Thank you, Doctor. Now, I think it would be wise to have the statement of Dr. John P. Hagen next and then we would like to ask you gentlemen a few questions.

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STATEMENT OF DR. JOHN P. HAGEN, DIRECTOR, VANGUARD DIVISION, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. HAGEN. Very good, sir.

Mr. Chairman, before giving you some of the technical background and statistics on yesterday's successful launching of the Vanguard II satellite, I would like to state for the record my deep respect for and admiration for the men and women who have been associated with me on the Vanguard team during the past 3 years. Their competence, loyalty, and untiring efforts have allowed us to achieve the very difficult goal we set for this project not too many months ago. I am sure you join me in expressing these sentiments to the group. As a part of the NASA organization we will apply the same diligence to more advanced efforts that has been applied to the Vanguard program.

The Vanguard II satellite 1959 alpha, the fourth in the series of satellite launching vehicles of the Vanguard program, is the second Vanguard satellite to be placed in orbit. The first, Vanguard I, which was carried in the third in the series of three-stage test vehicles for this program, was launched on March 17, 1958, to become the highest, longest-lived satellite yet placed in orbit. The present Vanguard II satellite carries a cloud cover experiment to record the cloud formation over the surface of the earth in the sunlight beneath its orbit, and to read-out this recorded data upon command from one of the minitrack tracking stations over which it passes. This data, in the form of magnetic tape, is then sent to the U.S. Army Signal Research and Development Laboratory at Fort Monmouth, N.J., where it is reduced to form a picture of the earth's surface over which the satellite has passed, showing the gross details of the cloud formations that existed at the time of satellite passage.

The launching vehicle for Vanguard II was the standard Vanguard vehicle, consisting of three stages and the satellite payload in a finless, bullet-shaped configuration about 72 feet long by 45 inches in diameter at the base. Gross takeoff weight, including first- and second-stage propellants, was 22,600 pounds. Total weight placed in orbit was over 75 pounds. This can be compared to the weights placed in orbit by previous satellites to understand the relative "fineness" of design exhibited by this vehicle. As an example, the Explorer vehicles weighed about 50,000 pounds at launch to place a total of about 31 pounds in orbit. As an additional consideration, none of these satellites produced nearly as high and long-lived an orbit as did Vanguard II.

Martin Co. is the prime contractor for the vehicle. The first-stage engine is manufactured by the General Electric Co., the second-stage engine is manufactured by the Aerojet-General Corp., and the third-stage engine is manufactured by the Grand Central Rocket Co., although a second company, Alleghany Ballistics Laboratory also has contracts for a third stage. They have produced an alternate third stage which has superior performance. The guidance components for the vehicle are provided by the Minneapolis-Honeywell Regulator Co., Air Associates, and Designers for Industry.

The first stage is a liquid propellant rocket, utilizing kerosene and liquid oxygen as propellants. This stage uses a gimballed engine con-

trolled by the guidance system in the second stage to provide a guided "boost" for the second and third stages.

The second stage is also a liquid propellent rocket, employing white fuming nitric acid and unsymmetrical dimethyl hydrazine as fuels. This stage contains the brains of the entire launching vehicle—the complete guidance and control system used during three periods of flight: (*a*) the first-stage powered flight, (*b*) the second-stage powered flight, and (*c*) the second-stage coasting flight. It also carries the third stage and the satellite package within its nose, protected by a special nose cone that breaks away halfway through second-stage powered flight, after the rocket has emerged from the denser layers of the earth's atmosphere. This stage also contains the mechanism for spinning the third stage prior to its ignition.

The third stage is a solid propellent rocket, without any steering controls of its own. This stage was alined at the proper angle by the second-stage guidance system while it was still within the nose of the second stage at the conclusion of the coast of this stage to its peak height. At this peak height, the third stage was spun to about 50 r.p.m., and ignited. After about 30 seconds of thrust it burned out, and the satellite was separated from it with a separation velocity of perhaps 3 to 5 feet per second. This velocity is sufficient to cause the orbit of the empty third-stage bottle and the satellite package to drift apart at a rate of about 60 miles per day. In other words, there are two satellites there and they become separated at this slow rate. The total weight placed in orbit was thus over 75 pounds—over 23 pounds of satellite components consisting of 20.75 pounds for the cloud cover satellite package, 1.1 pounds for the spin retard mechanism, and 1.3 pounds for the separation mechanism, including the heat shield, plus about 54 pounds of empty third-stage bottle.

The satellite payload on Vanguard II is a 20-inch diameter, 20¾-pound sphere, with a highly reflective surface designed to provide a balance between the heat from the sunlight and the internal batteries and the radiation from the satellite that tends to cool it off. This package contains a cloud cover experiment that is now measuring the distribution of the cloud cover over the daylight portion of the earth's surface over which the satellite is passing, plus a minitrack radio transmitter that provides a radio signal to the minitrack radio tracking network. The cloud cover instrumentation package was developed by the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, N.J.; the minitrack transmitter, the command receiver, and the satellite shell by the Vanguard Division of the National Aeronautics and Space Administration.

The cloud cover experiment transmits its data to ground recording stations whenever it is interrogated from a ground station. Radio transmission of the cloud cover data is at 108.03 megacycles at a power level of 1 watt, modulated by signals from 2,500 to 12,500 cycles per second. Expected lifetime of the batteries for both the experiment and its radio transmitter are at least 2 weeks. The minitrack transmitter transmits a continuous, unmodulated signal of 108.00 megacycles at a power level of one-one hundredth of a watt. The frequency of this transmitter is controlled by a quartz crystal that varies as a function of temperature, thereby permitting a ground determination of the internal package temperature by measurement of the re-

ceived frequency. Estimated lifetime of the batteries for this transmitter is at least 4 weeks. Unlike the Vanguard I satellite, which is still transmitting a strong tracking signal after 11 months, no solar batteries are used to power the transmitters in this satellite.

The cloud cover experiment utilizes two photocells at the focus of two optical telescopes aimed diametrically opposite each other at an angle by 45° from the satellite spin axis. These photocells pick up the sunlight reflected from clouds, land masses, and ocean areas of the earth as the satellite passes over the earth's surface. The spin of the satellite—at about 50 r.p.m.—causes the axis of the photocells to scan the earth in successive lines as the satellite moves forward in its orbit, producing a lined picture not unlike a television picture. The signals from these photocells are stored on a tape recorder within the instrumentation package. By means of separate solar batteries, the recorder is turned on only when the earth underneath the satellite is in daylight resulting in 50 minutes of data per orbit. Sufficient recording tape is provided—a 75-foot loop—so that all of the photocell scanning data obtained from the sunlit part of a single orbit can be accommodated. Once each orbit, a selected ground station is chosen to interrogate the satellite by means of a command receiver carried within the satellite, thereby causing the entire tape to be "played back" at a rate sufficient to read out all data in 60 seconds. At the ground station this data is recorded on a wide-band magnetic tape recorder, the tapes from which are immediately forwarded via airmail to the USASROL for analysis and conversion into cloud cover pictures.

Radio tracking for this satellite is provided by the minitrack network, including stations at Blossom Point, Md.; Fort Stewart, Ga.; Havana, Cuba; Quito, Ecuador; Lima, Peru; Antofagasta, Chile; Santiago, Chile; Antigua, B.W.I.; San Diego, Calif.; Woomera, Australia; and Esselen Park, Union of South Africa.

These stations, in addition to their radio-tracking equipment, also are equipped with special telemetry receivers, recorders, and ground interrogation transmitters. For the special signals expected from this satellite, the Army Signal Corps has installed special FM subcarrier units at the stations selected to interrogate this satellite—Fort Stewart, San Diego, Lima, Antofagasta, Santiago, and Woomera.

The tracking data from the minitrack stations are transmitted by teletype messages to the Vanguard Control Center of NASA at the Naval Research Laboratory here in Washington, and thence to the NASA Vanguard Computing Center, where the orbital elements, station predictions, and ephemerides are produced. These reduced orbital data in turn are transmitted to the control center for distribution to the USASROL, to the tracking stations, and to the other user groups, including the Smithsonian Astrophysical Observatory which has the responsibility for the optical tracking of this satellite, and to the spacetrack center for distribution to various military groups. The functions of the integrated minitrack network-Vanguard Control Center-Vanguard Computing Center as applied to this satellite are typical of all such operations to be provided for all future NASA satellite operations.

Now a word or two about the operation of the vehicle. The Vanguard launching yesterday was a highly successful scientific operation. The launching vehicle itself performed extremely well—in excess of the minimum performance required to achieve a successful orbit, in fact, performance was above nominal—or predicted—performance and approached the maximum achievable. All three stages of the vehicle, guidance, retro, and spin rockets, plus the satellite itself functioned in an optimum manner. The vital statistics below recount the sequence of events in the launching. Two sets of figures are given. The first column indicates the nominal or predicted performance. The second column shows the performance actually received. Although the figures are preliminary and therefore approximate, it is evident from these figures that our expectations were exceeded.

In the table you have before you, you will find that the first stage burned 145 seconds, or 3 seconds longer than anticipated; its velocity and burnout was a little over 6,000 feet per second, whereas it was predicted a bit under 6,000. The altitude at which it burned out was 40 miles, as opposed to a predicted 38.

The second stage also burned some 5 seconds longer than anticipated or a total of 261 seconds. The second stage burnout velocity was 13,650 feet per second; we had anticipated 13,000. The altitude at which the second stage burned out was 155 miles, where predicted was 146, and the period of second stage propulsion was 116 as against 114 seconds. The velocity increment of the second stage was 7,500 feet per second as against predicted 7,100, and the altitude increment, that is the added altitude due to the second stage burning, was 115 rather than 108 miles.

The velocity at projection, this is the velocity that put the satellite in orbit, was 26,954 feet per second, as compared with our predicted 26,505.

Finally the projection direction, that is the satellite has to be sent along a line quite parallel to the surface of the earth, that guidance was better than one-quarter of a degree whereas our predicted guidance was one-quarter degree.

The time was 11 hours 4 minutes 41 seconds.

Now, the orbit achieved has these figures attached to it. The perigee, or closest approach to the earth, is about 330 miles. We had anticipated 311. The apogee, or its greatest separation from the surface of the earth was 2,085 miles whereas we had predicted 1,548. The period of motion in the orbit, 126 minutes; for the smaller orbit it would have been 116. The velocity of the satellite changes, of course, as it goes around. It is most rapid when it is close to the earth. There it is 18,379 miles per hour. The velocity when it is out at apogee drops to 13,040 miles per hour.

Finally the inclination of the orbit to the equator is about 33°.

The CHAIRMAN. Thank you very much, Doctor. I want to say those are splendid statements. They give the committee exactly what the committee wanted, which is specific details.

Mr. FULTON. Those are fine statements and I am sure that is what the public wants.

The CHAIRMAN. I think, too, we can say that your action in sending Vanguard aloft is entirely successful, from your point, in every

detail. I, for one, feel that medals indicating the civilian achievement could well be awarded to those who took the key positions in this great and historic accomplishment. Your satellite, this time, is intended for a definite utility purpose. This is the first time that a satellite has ever been placed in orbit with the idea that we would actually get some financial advantage or economic advantage out of the action of the satellite.

Now I am wondering, however, and I want to ask you a question: Why was it planned to have an elliptical orbit rather than simply a circular orbit?

Dr. HAGEN. Well, sir, I think that can be answered this way: One plans a circular orbit, but in order to get one he has to have the operation of the vehicle predicted to a small fraction of a percent. Now, the elliptical orbit is just as useful for this purpose as the circular and therefore it is to be advised that he builds in a little extra performance to get the safety that comes with that extra performance, and this is what gives you then the elliptical orbit. It would require added equipment in the vehicle to cut off the propulsion at the right time to get a truly circular orbit. This is a degree of sophistication to which we will go some day, but we are not there now.

The CHAIRMAN. I know, Doctor.

In your statement you referred to the fact that it was planned to have an elliptical orbit rather than a circular orbit?

Dr. HAGEN. Yes, sir.

The CHAIRMAN. You didn't plan on a circular orbit?

Dr. HAGEN. That is the cushion, the safety margin that we built into the equipment.

The CHAIRMAN. Why were the solar batteries left out of this particular satellite?

Dr. HAGEN. Well, for two reasons: One, this would require a much greater or much larger power from the solar cells than our Vanguard I satellite has.

The other thing is we have to remember there is a long leadtime in building these complex satellites. This was started a long time ago, early in the program. At that time the art of solar batteries had not progressed to the point where one could safely predict that in the time element available he could have really reliable solar cells, and it was therefore planned at that time to use the batteries.

Mr. MILLER. Mr. Chairman, may I make a comment?

The CHAIRMAN. We saw those solar batteries down at Redstone, I believe.

Dr. HAGEN. Yes.

The CHAIRMAN. We were very much impressed by them. If the satellite were designed now, you would assume, would you not, that they probably would use a solar battery in this particular experiment?

Dr. HAGEN. Yes, sir, we can say in our going-on programs we are planning the use of solar batteries.

Mr. MILLER. Mr. Chairman, may I make an observation at this point?

The CHAIRMAN. Mr. Miller.

Mr. MILLER. I think they are to be congratulated on the fact that they went ahead with this and didn't wait until they had perfected the solar battery. This is a true scientific achievement that would not

have been possible in the time element had we waited for perfection in all of these things, and I think that contributes greatly to the success. We have it in orbit now, whereas, if we had waited, we would still have found something to do, and we wouldn't have it in orbit.

The CHAIRMAN. My question was not in any way intended as a criticism.

Mr. MILLER. I know.

The CHAIRMAN. I was merely inquisitive as to why it wasn't used. Do you have something to say on that?

Dr. SILVERSTEIN. Just on the same point:

Currently we are just now at the position of being able to provide 1 watt of power with solar batteries. It takes over a year to initiate a package like this and build it up to its environmental testing. That takes 6 months.

The CHAIRMAN. Have you received any pictures of cloud coverage yet?

Dr. SILVERSTEIN. The data has been received. It is received in the form of electrical pulses on a tape in the ground. These have been forwarded to be converted from these electrical pulses in almost the same way that you convert a television picture from pulses into a picture at a laboratory.

The CHAIRMAN. Is it similar to the method newspapers use in transmitting a picture by telegraph?

Dr. SILVERSTEIN. Yes; a facsimile.

The CHAIRMAN. When do you think those pictures will be available?

Dr. SILVERSTEIN. That is a guess, because the method used is electronic computing machinery, and the program needs to be checked to see whether it is corrected to the job, and this has not been done yet.

I would say if everything works well, that within the next several days we ought to have an idea.

The CHAIRMAN. Well, if everything works well and those pictures come out satisfactorily, we would be able to ascertain the cloud coverage and masses over the whole world—that is, the Northern Hemisphere—within a short period of time, wouldn't we?

Dr. SILVERSTEIN. Yes.

The CHAIRMAN. Then the Weather Bureau could go to work right away on the question of weather forecasts, using those pictures, is that correct?

Dr. SILVERSTEIN. Yes.

I would like to modify that in this way:

We look upon this as being the first step. This is establishing the technology of the use of the satellites to study cloud cover and weather information.

In our program we have advanced vehicles that will not only include infrared equipment such as this but will include equipment to take actual television pictures of the clouds and will include temperature measuring devices of the cloud temperatures, instruments to measure the content of the clouds, the water vapor level, the temperatures at the different levels.

Now, this is the advanced picture we will need before in truth, on a real time basis, the Weather Bureau will be able to predict weather.

The CHAIRMAN. What I want to do is tie it down, immediately,

as to some economic benefit to the people of the United States for the money expended.

Am I correct in saying the data will be immediately available for the Weather Bureau, and the National Science Foundation (which testified here the day before yesterday) for the purpose of studying the idea that we can better forecast the approach of weather, can forecast wet or dry weather, and can economically take steps—within our own country—to reduce our damages from loss due to drought and floods, is that right?

Dr. SILVERSTEIN. This is the intent, Mr. Chairman.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. I am certainly glad to have you gentlemen here.

I would yield to Mr. McCormack first.

Mr. MCCORMACK. No, go ahead.

Mr. FULTON. May I compliment you too, Dr. Silverstein and Dr. Hagen, both doctors, on the form of statement which you have used.

I have had some criticisms as to previous witnesses—they were so indefinite. I am sure the overwhelming majority of the public wants to know just what information you have given, and possibly in the propaganda or psychological warfare we are in, this is one of the best things we can have happen. I would join with the chairman, too, in saying to you that you have been a great help to the United States, and really, while it is a civilian program, it nevertheless has a great effect on our U.S. security.

I want to compliment you too on the fact that through this program we are the first people in the world to get away from the visual tracking and the simple kinds of tracking and moving into a Minitrack transmitter system.

Dr. Sheldon and some of us were in Amsterdam last year, and we had the Russian scientists explain how the students and people on the hilltops had cameras which were passed out to track satellites.

I think the public should know we have advanced on a broad field rather than in the narrow field of track and height. These are tremendous advances.

When you think of the photocells producing instantly repeated signals, it is really the first step toward television.

Likewise, for reconnaissance weather purposes, it is the first time that, for peacetime purposes, there has been something developed generally for the economic benefit of mankind. It is a tremendous step forward in peacetime use.

Russia does not have such a program, does it, as far as we know?

Dr. HAGEN. As far as we know, that is right.

Mr. FULTON. So it is about time Russia spoke up on peacetime use.

Another point is on guidance and control as well as on instrumentation. We on the committee can see that you have progressed a great deal further than the Russians have. Our secret and open testimony, as well as our inspection trips have shown that.

Now, there is one question.

The CHAIRMAN. Could I interrupt the gentleman just a moment? I want to announce to the committee that we are pleased this morning to have 10 representatives from the Argentine Congress from faraway South America. We are certainly pleased to have them here

this morning. We hope that they will take seats here and stay with us as long as they so desire.

I want to recognize them and say on behalf of the committee we are pleased that they have honored us with their presence. [Applause.]

Mr. ANFUSO. Mr. Chairman.

The CHAIRMAN. I interrupted Mr. Fulton.

Mr. ANFUSO. Will Mr. Fulton yield to me?

Mr. FULTON. I will be glad to yield.

Mr. ANFUSO. Mr. Chairman, I had the pleasure of meeting most of these gentlemen in Argentina and also last evening. They are contributing greatly in promoting good relations between the United States and Argentina, and I too want to join you in welcoming them this morning.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. We Republicans want them to know they are welcome here. There are still some of us left.

May I publicly thank Dr. Hagen, who several years ago was one of those who ignited me as an "eager beaver" in the satellite-missile field; so your influence has gone much further than just the physical.

Secondly, I want to thank Dr. Abe Silverstein for his interest in putting up with me on many many questions, off and on at times, and that also got me interested in many of these projects that are now in the course of coming into operation.

So you men are a sort of beacon light to us in this country and are doing much more than you think—more than just coming up with certain results. It is implementing our peacetime program; and, as our good chairman, as well as the chairman of our select committee previously, Mr. McCormack, has said, we are entering into space by peaceful means and dedicating it to peaceful purposes, and this is the best illustration of that point this morning.

May I ask, on the first page of Dr. Hagen's testimony, with the chairman's permission, at the end of the first paragraph it says:

> It has reduced to a form of picture the earth's surface over which the satellite has passed, showing the gross details of the cloud formations at the time of satellite passage.

Obviously that brings out the question, to any reasonable person's mind: How big a cloud can you pick out or how small a cloud?

Secondly, if you can go into small- or medium-sized clouds that might be in upper altitudes, it is obvious then that you could pick out larger nuclear atomic clouds or dust formations.

Is that possible with our present satellite? Are you able, for peaceful purposes, to pick out any nuclear or atomic explosions that might occur at any place on the earth's surface and do it instantaneously?

Dr. HAGEN. I think we would really prefer to wait until we have seen the reduced information from this satellite to know or to be able to say with any surety what the size, how much resolution in the cloud cover we will really attain.

The size of the spot which sweeps across the earth's scope is on the order of a few miles in diameter, but that depends on how high the satellite is.

Now, when these strips of view across the earth are put side by side, then one can assimilate a picture, and I think it is only in the doing

that we will really be able to tell how much detail we can garner out of the picture.

In answer to your second question, I think you can say this: Anything which is of sufficient magnitude and will have a different reflection coefficient from the land mass or sea mass will certainly be detected.

Mr. FULTON. So that from the periphery of 330 satellite-miles that you have achieved, you would then obviously while not being able to tell the details of it note the disturbance caused by any large nuclear atomic explosion, and you would be able to transmit it immediately?

Dr. HAGEN. I would think so, yes.

Mr. FULTON. And with your previous predictions having been carried out above 90 percent, I think that your prediction this time might be taken to be 90 percent true by an interested observer. This really outflanks the discussions that have been taking place on the control and inspection procedures of nuclear and atomic explosions, which have been pretty well bogged down at present.

Possibly we in the United States don't need an agreement now, because we have the method to do it where Russia doesn't, as far as we know, is that not true?

Dr. HAGEN. Well, it could be true, yes, sir.

Mr. FULTON. Well, I am very hopeful that it is true and want to congratulate you on that, because it certainly will give us immediate knowledge of anything that has happened either before or behind the Iron Curtain in the nuclear or the atomic field.

Might I ask you this: Is it possible, through some sort of an ion-emission tracking—say by some electronic means—to pick up the trail of missiles which might be going through the atmosphere near the level of this satellite? A satellite may be at its perigee, where the missile is at maximum ordinant. Do you think that is possible with the use of this kind of instrument? This would be a tremendous breakthrough and really it would outflank the Zeus system—we might not need it.

Dr. HAGEN. I think that is a matter than can only be answered by experiment. There have been some attempts in observing motions of satellites, here from the surface of the earth, to look for disturbances in the ionosphere, to look for their passage. But that work has not progressed to a state that we could say whether it was practical or not.

Mr. FULTON. But if we had a system of satellites that were orbiting, so we could get rather accurate coverage within a short period of time, we could pretty well have a network that would pick up any missiles that are going within the range of up to 1,500 miles, is that not right?

Dr. HAGEN. Provided one could detect the trail.

The CHAIRMAN. Provided one could detect what, Doctor?

Dr. HAGEN. Could detect the trail of the missile through the atmosphere.

Mr. FULTON. Well, the Navy is working on that, and if we get advances there, we might be able to have tracking for every kind of missile in the intermediate and ICBM range.

Thank you very much again.

I compliment you highly.

The CHAIRMAN. Mr. McCormack.

Mr. MCCORMACK. No questions.

Mr. RIEHLMAN. Mr. Chairman.

I don't have any questions, but I would like to join with you and the other distinguished gentlemen who have complimented these two distinguished American citizens for the accomplishment that has been brought forth by their efforts, and those that they have been associated with. I think that we are moving in the direction that all of us are vitally interested in, and I think that this accomplishment is one which we can look forward to for peaceful purposes and which can be used for military purposes if necessary and valuable information along those lines, I am sure.

Mr. MCCORMACK. I might say for the record, Mr. Chairman, how happy I am having been chairman of the select committee that reported the bill that created NASA—that this marked contribution shows what we have always contended: We have the brains; we have the facilities, and the question is the leadership. Not only as a member of this committee but as chairman of the select committee last year, I not only congratulate you but express my personal and official thanks.

The CHAIRMAN. Mr. McCormack did a magnificent job as chairman of the select committee, and we are glad that the genius of his judgment is now seen in the formation, organization and active work of the NASA.

Mr. RIEHLMAN. Mr. Chairman, could I be recognized just for one second, more because I want to pay my compliments to the distinguished majority leader of the House for his interest in this field, not since he became chairman of the special committee but several years prior to that while working with me on a special committee on research and development. Mr. McCormack, more than once, said to me that we were delving into one of the most important phases of the Government's activities that we could possibly be in, and his diligence and his interest are bearing fruit today in what we are seeing transpire before us and what has transpired in the last few months in our endeavors in research and development.

The CHAIRMAN. I am most happy that we recognize his contribution to this work.

Mr. Miller.

Mr. MILLER. Mr. Chairman, I too want to join in congratulating these gentlemen of NASA for what they have accomplished, naturally, and to pay my respects to the distinguished gentleman on my left for his contributions.

Doctor, I was struck by your statement, starting on page 4, where you say as a result of administrative review of the Vanguard history, NASA decided to postpone the Vanguard firing scheduled for December 1958 until February 1959 and provide time for objective technical review of the vehicle to determine whether additional steps might be taken to increase the probability of success, and continuing over where you say, whether these modifications definitely helped or not is questionable, but it was a good conservative engineering approach. Taking that second look—I don't know whether it developed anything or not—by disinterested people or people who apparently

were not interested the first time apparently did have some contribution, and I think you are to be congratulated, as this is a mundane thing, when you think of the romance of getting this thing into space. But it takes the mundane things to get it there. This is one of the things you are to be congratulated for doing, because I feel that that contributed greatly to the success of this undertaking.

I think we all owe you a debt of thanks for making assurance doubly sure by taking the second look before we started the countdown.

The CHAIRMAN. Mr. Anfuso.

Mr. BASS. Mr. Chairman.

The CHAIRMAN. I was ready to call on Mr. Bass, but he was not here. We passed him by.

I will call on Mr. Anfuso, and then go back. It will be tracking back, but I will be glad to do that.

Mr. Anfuso.

Mr. ANFUSO. Congratulations, gentlemen, and I want to say as a less-ranking member, how proud we are to serve on this committee with our distinguished chairman and with the majority leader.

We are very honored to be able to sit on a committee with the majority leader and our distinguished chairman.

Gentlemen, the Soviet Union as well as other nations can track the data from this satellite, isn't that right?

Dr. HAGEN. No, sir, it isn't. They can track the satellite by observing the Minitrack unmodulated transmitter, but the data from the satellite is only taken from the satellite on command.

Now, the transmitter which transmits the data is a higher powered transmitter and puts a fairly heavy drain on our batteries, and so in order to minimize the battery wear and to assure that the data is taken only by the groups that are capable of reducing it, we have not made public the means of triggering off the data transmission.

Mr. ANFUSO. I am glad to hear that, because I had heard differently.

Now, it is true that satellites will be able to spot airborne nuclear explosions, but can a satellite detect an underground nuclear test?

Dr. HAGEN. I think that depends upon the instrumentation, but in general one would say only if there is a visible disturbance up above the surface of the earth. Something would have to be changed to be seen.

Mr. ANFUSO. Thank you.

The CHAIRMAN. Mr. Bass.

Mr. BASS. I would like to ask one or two more questions about the characteristics of this new Vanguard.

Could you tell us more about the type of picture you expect to be reproduced? How will it compare to an actual photograph of the earth's surface? Will it be just like it?

Dr. HAGEN. Well, you know, when you look at a large-screen television, you see the lines in the picture. This will be similar to that. Now, I wouldn't want to give you the impression it will be a television picture of the earth in that sense. It isn't really, because the spot size is fairly large, but there will be presented in the reduction the equatorial band around the earth plus 40 degrees above and below the equator, and this will be crossed by these lines generated as the

satellite spins. There will be light and dark portions on those, and when you stand off from this presentation, you should in effect see a map of the earth with the superimposed cloud cover.

Mr. BASS. Would you see land masses and oceans?

Dr. HAGEN. Possibly. We would like to wait until we actually reduce the data before we say for sure that you can, but possibly you will be able to distinguish land masses and oceans and see the cloud cover over that.

Mr. BASS. You don't expect it to be as accurate as a photograph, then?

Dr. HAGEN. No; it will not be in that fine detail.

Mr. BASS. I gather this satellite will not be visible to the naked eye?

Dr. HAGEN. No; it will be about the brightness of one of the faintest stars that you could see, but since it will be moving, it will be very difficult to acquire with the naked eye. It would be much better to have a pair of binoculars and know just where to look.

Mr. BASS. Will it cover the entire world in its——

Dr. HAGEN. Between the latitude limits plus 33° and minus 33°. Now, you can see it a little bit further north because of its great height.

Mr. BASS. So it would not cover the two polar regions, the Arctic and the Antarctic?

Dr. HAGEN. No; it will not see the poles at all.

Mr. BASS. Thank you.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. I want to go back a moment, Doctor, to the discussion a few moments ago between the chairman and the gentleman from California, Mr. Miller, as to the solar batteries.

Now, you had solar batteries in your first instrument that you launched. Now, I don't think it is a matter of waiting to develop the solar batteries. Could you give me a specific reason why solar batteries were not used?

Dr. HAGEN. The solar cells in the Vanguard I satellite are connected just through diode elements to the transmitter so that the transmitter receives power only when it is in sunlight. The kind of solar power supply one would put into a device like this would have a storage system, and so the added problem of developing the kind of battery that will take this intermittent charging and discharging and still be available to run the experiment on demand, that is the kind of thing that had to be developed, and that does take a little bit of time.

I think Dr. Silverstein put his finger on the real reason why we didn't bundle something together quickly and put it in. The policy in the IGY satellite series has been never to fly something unless it has had and has passed very exhaustive ground tests. We try to fly only those things that are proven. So there just was not the time to get this complex battery system going.

Mr. SISK. Well, that was the point that I wanted to make, whether or not there was some reason which I was not aware of or which had not been brought out, some specific reason for not using solar batteries or some particular reason why they would not do the job for this particular type of operation.

I think I understand now your explanation on the matter.

I appreciate, by the way, Dr. Hagen, and you, Dr. Silverstein, being before us again this time. We are very happy to see you.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Dr. Hagen, this last shot must have some rejuvenating qualities about it. You look to me to be about 10 years younger than the last time you came before the committee.

Dr. HAGEN. It might have.

Mr. MCDONOUGH. I just want to add my congratulations to you for the successful shot, and I am curious to know if we could get any better observation if this satellite were going north and south instead of east and west?

Dr. HAGEN. In some ways; yes. If it were going north and south, then during the course of a day, one would have a complete coverage picture of the earth. However, it would take a half day in order for the earth to turn under the orbit to get this picture. As it is now, we get a complete picture of the equatorial belt in the 2 hours that it takes the satellite to go about.

Mr. MCDONOUGH. Now, if you can discern on the screen after you have had the return information from the satellite a cloud formation, can you then spot that on the globe as to where it is located?

Dr. HAGEN. Yes, sir; and we can then, by observing it in future passes, watch its motion, and this is the real point behind the experiment, to see how these cloud masses do move.

Mr. MCDONOUGH. That is the next time around, and make a continuous study of it as it goes around, how these cloud masses move?

Dr. HAGEN. Yes.

Mr. MCDONOUGH. Do you plan on shooting one north and south?

Dr. HAGEN. Not in the IGY or Vanguard series, but in the going-on program; in the NASA future program, there certainly will be polar satellites.

Mr. MCDONOUGH. In the radio broadcast concerning it, I think the statement was made that the equipment that you have in this satellite is crude and can be refined and bettered.

Now, if we know that, why don't we have it? Why didn't we put it into this satellite?

Dr. HAGEN. Well, I would take exception to the word "crude." This is an experiment, and Dr. Stroud and his people, who developed the apparatus, have developed a very refined piece of gear. It does a very specific thing, however, and the experiment is one with limited objectives.

The reason is that that is all of the weight that was available for this kind of thing. Now, once this experiment begins to pile in its information, we will be guided by it in the kind of gear that will be put in the following going-on weather satellites.

As Dr. Silverstein pointed out, we already are planning to put not only this kind of detector but to put several of this kind, and also to put actual television cameras in these future satellites.

Mr. MCDONOUGH. Was the thrust that you used in this shot more than enough to put this weight into orbit?

Dr. HAGEN. Yes, sir; within limits. We had this safety factor. We could probably have put almost twice the weight, but we then would not have had our safety cushion.

Mr. MCDONOUGH. In other words, to me, the weight of it and the equipment and the performance as described seems to be rather mirac-

ulous because to accomplish that in such a small object, it seems you could accomplish more if you had a larger object and larger equipment.

Would that improve it?

Dr. HAGEN. Yes, sir. This is very definitely our aim, and we are in the middle of preparing just such a thing.

Mr. BASS. Would you yield, Mr. McDonough?

Mr. MCDONOUGH. Yes.

Mr. BASS. Dr. Hagen, why was it decided to put this satellite in an east-west orbit rather than a north-south orbit?

Dr. HAGEN. For several reasons. Remember that this was a whole program, with many different experiments in it. The people in the National Academy discussed the relative merits of polar and equatorial orbits. The decision that came out of these discussions was that an inclined orbit, one that wasn't truly equatorial but one that had a middle inclination, that would be a compromise between the equatorial and the polar orbit, was chosen. There was another factor that made that choice easy, and that is we had one good place from which to launch a rocket of this size, and that was Cape Canaveral in Florida. We are there under very strict range safety controls. No missile can be launched there that can possibly do damage to personnel or property, and so there is a very narrow range of azimuths over which one can launch. If we were to launch a polar orbit from there, the missile would have to pass over either South America or New York City, and this is ruled out. So we go over the Atlantic Ocean and get this intermediate orbit.

Mr. MCDONOUGH. Can't you use Vandenberg? You wouldn't have that danger there.

Dr. HAGEN. Yes, sir; that is one of the prime reasons for using Vandenberg.

Mr. FULTON. But you might hit the Russian hydrographic ship wandering around the Pacific missile range.

Dr. HAGEN. The chance is probably one in a million as to that.

The CHAIRMAN. Mr. Mitchell.

Let me say this before the gentleman begins his questioning:

We had here this morning, set to hear in executive session, Dr. York, Mr. Roy Johnson, and Mr. Holaday. Of course, the satellite has intervened, and that is one of the numerous interruptions, no doubt, we will suffer from satellites in the future.

As a result of it, I think it might be wise if we release Dr. York and Mr. Johnson and Mr. Holaday.

Could you come this afternoon at 2 o'clock? We could have that executive meeting this afternoon, if you would be able to be here.

Dr. York, would you be able to be here this afternoon?

Dr. YORK. Yes, sir.

The CHAIRMAN. How about Mr. Holaday and Mr. Johnson?

Mr. JOHNSON. Very well.

The CHAIRMAN. Thank you.

The CHAIRMAN. As far as we are concerned we can release you this morning.

Mr. HOLADAY. I will have to change my schedule around a bit. I have made appointments for all afternoon. I could change it around if the committee desires.

The CHAIRMAN. Mr. Ducander, can we have them in the morning?

Mr. DUCANDER. Yes.

Dr. YORK. Tomorrow morning would be just as bad.

The CHAIRMAN. Then we will have them this afternoon, because that will speed up our schedule. So if you can be here at 2 o'clock this afternoon, we will appreciate that. We will use you first, sir, so you can get back to your appointment. Thank you very much.

Now Mr. Mitchell.

Mr. MITCHELL. Thank you, Mr. Chairman, I have no questions, but concerning the interrupting, I am sure that the Chairman would welcome any interruptions of this nature during the session of Congress when we have such a successful event. I just want to join with you, Mr. Chairman, in extending my congratulations to both Dr. Silverstein and Dr. Hagen and all of your team. It certainly is a remarkable accomplishment. I think you sense the pride that each of the individual members of this committee feel in your mission and the success of it and I think that the pride that we feel is merely a reflection of all America and I only have this comment to make: You know I have been thinking about the contrast in your appearance here some 12 hours after this successful launching, the contrast between your appearance today and what it would have been had the missile burned out and collapsed on the pad, but I am certainly glad it did not.

Congratulations.

Dr. HAGEN. Thank you.

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Mr. Chairman, I have two questions.

Dr. Hagen is there a Mrs. Hagen?

Dr. HAGEN. Yes, sir.

Mr. QUIGLEY. I would like to pay tribute to her and to all of the wives who have been involved in this Vanguard program. I suspect that they are the unsung heroines of the space age. I suspect they have had a pretty rough 15 months. The chapter closed as of 10:55 yesterday morning.

Mr. MILLER. If you will yield a minute, there are also Peter and Christoper Hagen, too.

Mr. QUIGLEY. I am glad to hear that, but I want to pay tribute to Mrs. Hagen and to the wives who I believe have been under tremendous pressure for the past year or year and a half.

The CHAIRMAN. Mr. Wolf.

Mr. QUIGLEY. I have one more question of Dr. Silverstein.

The CHAIRMAN. I am sorry.

Mr. QUIGLEY. Doctor, on page 4 of your testimony, you said that the Vanguard vehicle is comparable in complexity and application of advanced techniques to military ballistic missiles. Its early flight experience is substantially the same as that of other missiles whose failures and successes were not made a matter of public record. In the light of that and in the light of the whole experience we have had in connection with the Vanguard program, do you think that there would be a certain wisdom and a certain prudence if in the future we did not give too much advance publicity as to what we planned to do and to hold that publicity and give it to our accomplishments after they become a reality?

Dr. SILVERSTEIN. I would agree with that wholeheartedly.

Mr. QUIGLEY. Because I suspect that the great heat that you two and this whole program have been under has been increased by the fact that we publicly announced what we were going to do. Actually it was what we hoped to do, but in the minds of the general public this becomes what is expected and when we do not do it, you people are on the pan. That is all, Mr. Chairman.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Mr. Chairman, gentlemen, I would like to concur with Mr. Quigley in the trials and tribulations of the family and to say I wish to add my congratulations too. I have no questions, Mr. Chairman, but I have a statement I would like to put in the record if I may.

I would like to say that I hope that our committee will encourage our Radio Free Europe and Voice of America and other media which submit and transmit material to the captive peoples to tell them the great progress that we have made here in the use of this satellite for peaceful use. I think this particular Vanguard II demonstrates our desire to help civilization in a very positive way and I hope that as a committee we can make some recommendation of this kind, that these things will be transmitted.

The CHAIRMAN. I think that is an excellent idea.

Mr. Karth.

Mr. KARTH. Mr. Chairman, I have no questions but I should like to join my distinguished colleagues in expressing thanks and deep appreciation to you two gentlemen who have contributed—undoubtedly quite creditably, too, I might say—to the prestige of the United States of America in the eyes of the free world in this accomplishment that has been made. I think that it is a real debt of gratitude that the American people and we owe you two gentlemen. Thank you very much.

The CHAIRMAN. Mr. King.

Mr. KING. Mr. Chairman, yesterday several questions were asked by committee members relative to the distribution of information, the dissemination of technical information, here in America. We had some good answers to those question, but it has been called to my attention that on December 7, the President's Science Advisory Committee issued a statement on that very matter, a very thorough and adequate statement signed by Dr. James R. Killian, Chairman, and the other members of that Committee, including Dr. York. I should like to request that this be made a part of the record.

The CHAIRMAN. If there is no objection, so ordered.

(The statement referred to is as follows:)

IMPROVING THE AVAILABILITY OF SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED STATES

A report of the President's Science Advisory Committee

WHAT THE PROBLEM IS AND WHY IT IS SERIOUS

The long, hard look we have recently taken at the state of science and technology is this country has brought to light several areas that need to be strengthened and improved. Some of these, notably in the field of education, have aroused nationwide concern. But another area—also in great need of attention—has attracted little or no public interest. This is the matter of scientific information—the technical data that a scientist needs in order to

do his job. Yet our progress in science may very well depend upon the intelligent solution of problems in that area.

All of us use a wide variety of information every day of our lives. We glean it from newspapers, conversation, radio and television, magazines, clocks, books, meters, mail, maps, and so on. The scientist, however, is interested in the specialized information that results from scientific research. The publication of of research information is absolutely essential to every working scientist for two reasons: (1) It is the means by which he announces significant results in his own work, establishes priority where appropriate and invites the evaluation of other scientists; (2) it is also the means by which he keeps abreast of what others are doing in his field.

The extent to which the working scientist depends upon the work of others has been clearly stated by one of the greatest of all scientists, the atomic physicist, Ernest Rutherford. As quoted by James Newman in a recent issue of "The Scientific American," Lord Rutherford said:

"I have also tried to show you that it is not in the nature of things for any one man to make a sudden violent discovery; science goes step by step, and every man depends on the work of his predecessors. When you hear of a sudden unexpected discovery—a bolt from the blue as it were—you can always be sure that it has grown up by the influence of one man on another, and it is this mutual influence which makes the enormous possibility of scientific advance. Scientists are not dependent on the ideas of a single man, but on the combined wisdom of thousands of men, all thinking the same problem, and each doing his little bit to add to the great structure of knowledge which is gradually being erected."

The reason scientific information has become a major problem, particularly since World War II, is that the rapid rate of scientific progress has multiplied the volume of scientific information to a point where it can no longer be published and handled within the framework of existing methods. When one considers, too, that much of what is significant in science is being published in unfamiliar languages, it is clear that the working scientist is faced with almost insuperable problems in attempting to keep himself informed on what he needs to know.

Some idea of the volume of increase may be had from the fact that the science and technology periodical collections of the Library of Congress have doubled approximately every 20 years for the past century and now contain approximately a million and a half volumes, a significant fraction of the Library's total bound collections. The Library is receiving journals in science and technology at the rate of about 15,000 annually, and 1,200 to 1,500 new periodicals are appearing each year. Yet the Library receives less than a third of the 50,000 scientific periodicals that appear in the world list of 1952 and it is expected that by 1979 the total world output will reach 100,000 journals.

The language difficulty is reflected in the fact that Russian-language publications are estimated to account for a tenth or more of all the scientific literature being published in the world today. This Russian total is second only to English.

Reduced to simple terms, the scientist's problem with respect to information is: How can the present volume of research results be published promptly? What is being published now? Where is it? and How can I get at it? The purpose of this paper is to examine these problems and to suggest possible ways in which they can be solved. In particular, it will consider the question of what should be the responsibility of the Federal Government in meeting this crisis.

THE PRESENT SYSTEM

The system by which scientific information is disseminated is the result of evolution rather than any preconceived system or plan. Its defects stem largely from its inability to keep pace with the increasing volume of scientific results and literature and the absence of techniques geared to the newer forms of scientific information, such as Government reports. The situation is further complicated by the fact that a large and important proportion of the world's scientific literature appears in languages unknown to the majority of American scientists, such as Russian and Japanese.

Scientific information appears in several forms. Most significant are the highly specialized technical periodicals, called primary journals, because it is in these that new scientific results are first published. The Physical Review, Journal of the American Chemical Society, and the Aeronautical Engineering Review are examples.

Another important primary source is the monograph, an exhaustive study of some highly specialized phase of science. Because it is of interest to only a limited number of scientists, and because it often includes elaborate charts and plates, the monograph is almost prohibitively expensive to publish. The result is a lack in this country of monographs on many exceptionally important scientific subjects that should be so covered.

A second important category is the abstracting journals, such as Biological Abstracts and Chemical Abstracts. These contain summaries of synopses of papers that originally appeared in primary journals. When adequately indexed, they permit a searcher to locate previously published papers on any given subject. If an abstract is sufficiently informative, it may serve the scientist in lieu of the complete paper. It should be noted parenthetically, however, that the 14 major scientific abstracting services in the United States recently indicated that the almost half a million abstracts that they issue annually constitute only about 55 percent of what they should be publishing in order to cover the literature in their combined fields reasonably well. Other important secondary sources include critical reviews, special indexes and indexing services, bibliographies, title lists, collected tables of contents, handbooks of data, and compendia of various kinds.

A recent trend of special interest is the establishment of data centers. When the quantity of research data in a given field becomes too great for book publication to be practical, the data center offers a solution. Such centers compile, correlate, standardize, and organize numerically, data representing the properties of materials or the characteristics of phenomena. Examples of such centers include the Thermophysical Properties Research Center at Purdue University; American Petroleum Institute Research Project 44 at the Carnegie Institute of Technology, which is concerned with the physical properties of hydrocarbons; the Nuclear Data Project of the National Research Council; and the National Bureau of Standards Center on Selected Values of Chemical Thermodynamic Properties.

Falling outside scientific information that is published, cataloged, and indexed in the normal way, is a steadily mounting volume of Government research reports. It is conservatively estimated that upward of 50,000 scientific reports (at least half of which bear no security classification) are issued annually by the private and Government laboratories that conduct federally sponsored research. Many of the newest and most significant scientific data are to be found in these reports.

A smaller body of scientific information not covered by the normal processes is to be found in such material as research findings submitted in satisfaction of Ph.D thesis requirements, industrial reports and papers presented at scientific meetings and symposia.

At the present time it is not even possible to answer the question with any degree of completeness, "What is being published now?" One would assume that, somewhere in the world, there must be a composite listing of the world's scientific—publications—perhaps even arranged by subject fields—but no such compilation exists. The establishment of such a list and its maintenance on a current basis obviously would be a very expensive undertaking, and this is one reason why it has never been done.

The basic answer to "Where can I find it?"—as far as journals are concerned—is the "Union List of Serials," in the libraries of United States and Canada. Such a compilation lists periodicals alphabetically and names the libraries where each can be found. But no such union list of scientific journals now exists. A joint committee on a union list of serials covering all fields has estimated that the science and technology portion of a new union list would cost approximately three-quarters of a million dollars. It could be kept up to date only in a relative sense, since such a list is constantly changing. It follows, of course, that no comprehensive listing of the principal secondary publications is in existence either.

Then there is the problem of "How can I get it?" The scientist who needs a particular journal may find himself (if the journal is rare) far distant from the location of the nearest copy as indicated by the union list; or he may find that the article he is seeking is in a language he does not read.

In summation, then, it may be said that both inside and outside the normal channels of scientific communication a mounting flood of scientific data threatens to swamp even the most zealous research investigator. The implications go far beyond the inability of one man, or even a group of men, to keep abreast

of development in their field. Our very progress in science is dependent upon the free flow of scientific information, for the rate of scientific advance is determined in large measure by the speed with which research findings are disseminated among scientists who can use them in further research.

HOW ARE WE GOING TO MEET THIS PROBLEM?

The situation has evolved over a lengthy period of time, during which the developing problems not only have been recognized, but have been the subject of attack on a number of separate fronts. These efforts have been handicapped, however, by the lack of overall coordination and sufficient funds with which to support really effective remedies.

What is already being done?

All along the line there have been sincere efforts to cope with the problems. Primary journals have expanded substantially in recent years and the scientific societies have helped to cover the increased costs by raising dues and subscription prices. In an effort to conserve space, greater and greater condensation of papers is being required, with the result that there is danger of few people besides the author and his immediate colleagues being able to understand a paper. There is constant search for cheaper production methods and many journals levy page costs upon the authors, so that scientists must pay for the privilege of having their research findings published. Such financial help as the Government has given has been limited, consisting largely of short-term emergency grants made to tide a particular journal over a rough spot or to launch a new journal that is badly needed in order to fill a gap. Some agencies pay page costs for their employees and their contractors' employees when they publish.

Federal aid has also been provided in the form of temporary assistance to commercial abstracting and indexing services, including funds to support the establishment of a National Federation of Science Abstracting and Indexing Services, designed to bring cooperative efforts to bear upon mutual problems. A few Government agencies publish or partially support certain secondary publications in subject fields of particular interest to them.

It is generally agreed, however, that the magnitude and seriousness of the problem are such that a long-term solution requires fundamental research into the problem and widespread application of machine methods and techniques. In other words, science must look within itself for a new system that will meet present-day requirements for the location, storage, and retrieval of scientific information.

A number of industrial firms have developed, and are using successfully, mechanized storage and retrieval systems tailored to their own needs. Large manufacturers of business machines and computers are becoming increasingly interested in the application of their equipment to information-processing problems. A dozen or more universities are carrying on research in the information-handling field, including studies of existing patterns of scientific communication in various subject fields, research in mechanical translation, development of procedures for determining how scientists use technical information, and research on actual mechanical systems for information storage and retrieval. Within the Government, the National Science Foundation has supported research on scientific information problems to the extent that available funds have permitted.

Efforts are also being made to improve the availability of foreign scientific information. The emphasis is on Russian research results because Soviet scientific publications are second only to our own in number, and because so few scientists in this country read Russian. Of the 61 Soviet journals available here on subscription in cover-to-cover translation, about 34 are being supported principally by the National Science Foundation, with assistance from the Atomic Energy Commission and the Office of Naval Research. Nine are supported by the National Institutes of Health; the rest are issued commercially.

In the field of unpublished documents the Office of Technical Services, Department of Commerce, lists some 7,500 such documents each year in its abstracting journal "U.S. Government Research Reports." Copies of all items so announced can be obtained in original form or in photoreproduction. The Library of Congress is building in its Science and Technology Division an open reference collection of unclassified reports. The National Science Foundation

maintains a clearinghouse for Government research information to provide scientists information on Government-supported research in their fields and the reports that are available.

Thus a considerable amount of work is being done on serious scientific information problems. From the standpoint of national welfare, however, these efforts are on far too small a scale to deal with the overall problem. The question then remains as to how it can be met.

What should be done for the future?

Two alternative possibilities have been advanced. One would be the establishment of a large and highly centralized scientific information agency, financed by the Federal Government or by Government and private industry. A second would be the establishment of a science information service of the coordinating type, which would strengthen and improve the present system by taking full advantage of existing organizations and the specialized skills of persons with long experience in the field. Let us examine the respective merits of these alternatives.

A single large operating center? The proposal to solve existing problems in the field of scientific information by the establishment of a single large operating center, financed wholly or in part by the Federal Government, may have been suggested by the experience of the Soviet Union with its All-Union Institute of Scientific Information. The organization and operation of the institute implies that the Russians recognize the magnitude and importance of the problem by their decisive and aggressive attempts to meet it. Available evidence indicates that the institute operates effectively in meeting the needs of Russian science. But it must not be overlooked that in planning the establishment and operations of the institute, the Russians could not call upon the services of scientific information organization such as we find already in existence in the private enterprise structure of our country, and which have been in operation many years.

The solution the Russians have developed for meeting their own problems in our judgment would not be equally effective in meeting ours. The Russian institute is organized along the lines that are basically compatible with the organization and administration of research in the Soviet Union which, of course, is controlled by the Central Government. Our own research efforts are organized and administered very differently, and it is illogical to suppose that a highly centralized organization for the dissemination of research information would serve our purposes equally well. Whatever its faults may be, our present system has developed along the lines of individual initiative and private enterprise that are very basic to our institutions.

The primary journals, as well as the abstracting services, are published under the benign auspices of the scientific societies who are in a better position than anyone else to appreciate the information problems of scientists. Existing services, moreover, represent a considerable investment of private capital. "Chemical Abstracts," for example, which has operated without Government subsidy, had a 1957 budget of approximately $1.5 million. Although most of the journals and services have smaller budgets and many do receive some Government support, the total private investment in the publication and dissemination of results of scientific research runs into many millions of dollars. The mere mechanics of transforming the existing decentralized system of private enterprise into a strong central agency are enough to stagger the imagination.

From a purely practical point of view, it must be remembered that much of the day-to-day work involved in the dissemination of scientific information—that is, the writing, editing, abstracting, translating, and so on—is done either by scientists or people with technical skills of a very high order. Many of these people perform such chores in addition to their regular scientific work and it is quite inconceivable that they could be induced to affiliate themselves on a full-time basis with a centralized agency. Put the matter another way: The case for a Government-operated, highly centralized type of center can be no better defended for scientific information services than it could be for automobile agencies, delicatessens, or barber shops.

A science information service? The second alternative, however, could lead to an integrated, efficient, and comprehensive scientific information service that would take advantage of privately supported programs as well as the very extensive work being done by the Federal agencies—that is, it would strengthen rather than supplant them. Specifically, this solution calls for the establishment within the Government of an organization that might be called a Science Information Service. Such a Service would assist, cooperate with, and supple-

ment the many existing scientific information programs but would take over none of them. It would retain the benefits of the existing complex of scientific information services while working at the same time toward remedying its defects. Such a program would be in the best American tradition of private enterprise and Government working together voluntarily for the national good.

The Service would have two important functions: (1) Through effective coordination and cooperative effort of public agencies and private organizations to capitalize upon and improve existing facilities and techniques in such a way as to afford immediate relief to short-term problems of a pressing nature and (2) to encourage and support a fundamental, long-term program of research and development, looking to the application of modern scientific knowledge to the overall problem through the application of machine techniques and through yet-undiscovered methods.

Under the first category the Service would help to answer the scientist's fundamental questions: How can the present volume of research results be published promptly? What is being published now? where is it? and how can I get it?

In the area of primary publication, the Service would provide financial assistance where needed for the publication of journals and monographs. It would encourage publishers and scientific societies to experiment with new and streamlined methods of publication designed to increase efficiency, improve services, and decrease costs. Similarly cooperation would be encouraged among the producers of secondary publications, and financial assistance provided when necessary.

The Service would provide the answer to "What is being published now?" by sponsoring, and if necessary supporting, the immediate preparation of worldwide lists of both primary and secondary scientific research publications, subject classified and indexed. It would perform a similar task with reference to a union list of scientific and technical periodicals and provide a clearinghouse of information on abstracting and indexing services throughout the world. It would review the newly developing field of data centers, compiling information on those that now exist, analyzing overlaps and duplications, and defining areas where new centers are needed.

The whole area of foreign scientific information would be scrutinized and the translation of Russian science expanded to the extent needed to provide full coverage. Additional translation program in Japanese and other languages would be initiated as needed.

The Service would give special attention to the area of Government scientific reports by expanding the existing announcement system to include every significant unclassified report. It would also expand and improve facilities for making copies of these reports available upon request. It would foster cooperative projects among the agencies to promote greater efficiency in the preparation, processing, and dissemination of Government reports.

It would seek to expand and improve interlibrary exchange agreements throughout the world, photocopying processes, and other ways and means of bringing to the scientist copies of items unattainable through normal channels.

All of these things, the Service, with sufficient funds and backing, could proceed to do at once. For the longer term, the Service should support a continuing program of research and development through grants and contracts, looking to the widespread application of machine techniques to such problems as storage, retrieval, indexing, and on a higher plane, to such problems as translation and abstracting.

CONCLUSION

It is clear that in the realm of scientific information, the scientist has neglected his own needs. As a nation we have readily applied modern scientific knowledge to the solution of much more difficult problems. If the Federal Government will establish a national coordinating service of the type that has been described, we can move toward solution of a problem that is vital to our progress in science.

Fortunately a new agency will not be required to meet this need. The National Science Foundation, whose enabling act charges it with specific responsibilities for scientific information, already has a pilot program in this field and hence useful experience and special competence. The Foundation plays a coordinating role with respect to basic research and policy matters within the Federal Government. The establishment of the Science Information Service within the Foundation could be easily achieved by the extension of the Foundation's present program.

The Committee therefore recommends that the National Science Foundation expand its scientific information program to constitute a Science Information Service that would serve to aid and coordinate existing governmental and private efforts.

Dr. James R. Killian, Jr., Chairman;
Dr. Robert F. Bacher,
Dr. William O. Baker,
Dr. Lloyd V. Berkner,
Dr. Hans A. Bethe,
Dr. Detlev W. Bronk,
Dr. James H. Doolittle,
Dr. James B. Fisk,
Dr. Caryl P. Haskins,
Dr. George B. Kistiakowsky,
Dr. Edwin H. Land,
Dr. Edward M. Purcell,
Dr. Isidor I. Rabi,
Dr. H. P. Robertson,
Dr. Paul A. Weiss,
Dr. Jerome B. Wiesner,
Dr. Herbert York, and
Dr. Jerrold R. Zacharias.

MEMBERSHIP OF THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE

Dr. James R. Killian, Jr., Chairman, Special Assistant to the President for Science and Technology, the White House.
Dr. Robert F. Bacher, professor of physics, California Institute of Technology.
Dr. William O. Baker, vice president (Research), Bell Telephone Laboratories.
Dr. Lloyd V. Berkner, president, Associated Universities, Inc.
Dr. Hans A. Bethe, professor of physics, Cornell University.
Dr. Detlev W. Bronk, president, Rockefeller Institute for Medical Sciences and President, National Academy of Sciences.
Dr. James H. Doolittle, vice president, Shell Oil Co.
Dr. James B. Fisk, executive vice president, Bell Telephone Laboratories.
Dr. Caryl P. Haskins, president, Carnegie Institution of Washington.
Dr. George B. Kistiakowsky, professor of chemistry, Harvard University.
Dr. Edwin H. Land, president, Polaroid Corp.
Dr. Edward M. Purcell, professor of physics and Nobel laureate, Harvard University.
Dr. Isidor I. Rabi, professor of physics and Nobel laureate, Columbia University.
Dr. H. P. Robertson, professor of physics, California Institute of Technology.
Dr. Jerome B. Wiesner, director, Research Laboratory of Electronics, Massachusetts Institute of Technology.
Dr. Herbert York, Chief Scientist, Advanced Research Projects Agency, Department of Defense.
Dr. Jerrold R. Zacharias, professor of physics, Massachusetts Institute of Technology.
Dr. Paul A. Weiss, Rockefeller Institute for Medical Science.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. I wish to add my comments and compliments to everything which has been said here. I think the achievement has been a stimulating one for each of us. The committee has listened to some fine reports and these are the finest we have received. I want to add to what Mr. Miller has said, the gentleman from California, about the delay that you had from December to February. I think the idea of submitting this whole program to the eyes and review of others is a great thing and one which should be carried out to the other various stages of the program all of the way down the line because this objective type of criticism, this objective type of help certainly can be of great assistance, as you have pointed out here, and as you have proven. It shows that you have not only the scientific

capacity but also a great administrative ability within the program which you are running.

I wish to thank you especially for that. That is all, Mr. Chairman.

The CHAIRMAN. Any further questions? Mr. Ducander, do you have any questions?

Mr. DUCANDER. No, sir; no questions.

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. Dr. Silverstein, as you know, I have been interested in the radio telescope at the University of Manchester and have previously expressed my interest in the experiments being made by Dr. Lovell at that installation. I likewise am interested that any place in the world that we have these scientific installations that they be used to the full, so that in the free world we use our scientific installations.

Secondly, it eliminates the expense of duplicating the installation. Are we working out anything with the University of Manchester at using that radio telescope time that seemed to be vacant last year? Has anything been done on that?

Dr. SILVERSTEIN. Yes, sir; we have worked out something with them. We are also talking currently with the Australians who have a radio telescope and will expect to move in some direction here.

Mr. FULTON. So that the financial difficulties, then, have been overcome for the telescope. The Parliament of Britain had recommended against spending too much money on experiments. That problem has had U.S. help.

Dr. SILVERSTEIN. I believe it is still in the hands of the contract people. I believe the decision has been made to go ahead. I do not know personally at the present time what the state of the experiment is from a contractual standpoint.

Mr. FULTON. Those experiments are to go out 2 billion light years, 6 trillion miles each in tracking stars and making outer space research, so I feel they should be continued. Don't you, too?

Dr. SILVERSTEIN. Yes.

Mr. FULTON. Thank you.

The CHAIRMAN. If there are no further questions——

Mr. MCDONOUGH. Mr. Chairman.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Just one further question. Has the orbit of this satellite confirmed the fact that the earth is not a sphere or is a pear-shaped as has been indicated?

Dr. HAGEN. We would have to wait quite some long time before we could answer that. We would have to observe the orbit and then observe the changes in the oribt which take many months to develop so that this will add to our knowledge of the shape of the earth, but the experiment is probably going to take a year to do.

The CHAIRMAN. If there is no further business, the committee stands adjourned until 2 o'clock this afternoon.

(Whereupon, at 11:40 a.m., the committee adjourned, to reconvene at 2 p.m., the same day.)

AFTERNOON SESSION—EXECUTIVE SESSION

The committee met at 2 p.m., in room 356, Old House Office Building, the Honorable Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order.

This afternoon we have the program which had been planned for this morning, and the first witness this afternoon is Dr. York.

Then we have Mr. Roy Johnson, and then Mr. Holaday.

Now, Dr. York, any way that you wish to present your security hearing this afternoon will be satisfactory with the committee. Do you wish to be the first witness or Mr. Johnson or Mr. Holaday?

Dr. YORK. Well, it is at the committee's pleasure.

Mr. Johnson does have a presentation to make. I don't. I am here to answer questions which I couldn't answer yesterday that came up in the course of the hearing. Whatever is the committee's pleasure is fine with all three of us, I am sure.

The CHAIRMAN. Well, I would personally feel if we had a program to be put on, we should get to that as soon as we can, so we will have the program that you people have to present to us. Then we could question the several witnesses.

Dr. YORK. Well, the questions you asked me yesterday that I couldn't answer were about the Nike-Zeus and that is not a part of the program that Mr. Johnson would give.

The CHAIRMAN. Well, if you wish to proceed that way, Doctor——

Dr. YORK. With the space program first, is that what you would like to hear?

The CHAIRMAN. Whatever you say you want first is all right. I would say we better proceed with the program that is set up in the regular course and then ask the questions afterward, because I know myself, and I know the members of the committee well enough to know if we start asking questions to start with, we will not get to the prepared program.

We have a bill on the floor, and we now have permission to sit during the general debate. When that general debate is terminated, we will have to leave and go over to the floor. So why not put on your regular program and then we will come to the questions.

Mr. JOHNSON. Thank you, Mr. Chairman.

We have with us some associates, Colonel Lay, one of our chief technicians in ARPA, Mr. Godel, and Mr. Gise, and I would like Colonel Lay to identify those men from DOD who are here.

The CHAIRMAN. This is classified hearing. Is everybody here cleared?

Mr. JOHNSON. Well, we will take responsibility for DOD people.

Would you identify us?

Colonel LAY. Yes, sir.

There are three gentlemen here in the back that are ours, and these gentlemen right here are ours [indicating], and we are all cleared.

The CHAIRMAN. Mr. Ducander, are our people cleared?

Mr. DUCANDER. Yes, sir.

The CHAIRMAN. All right, we are formally in executive session.

Mr. JOHNSON. Colonel Lay and several others will assist with the charts.

STATEMENTS OF DR. HERBERT F. YORK, DIRECTOR, DEFENSE RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE; ROY JOHNSON, DIRECTOR, ARPA; WILLIAM M. HOLADAY, DIRECTOR OF THE OFFICE OF GUIDED MISSILES, DEPARTMENT OF DEFENSE, CHAIRMAN OF THE CIVILIAN-MILITARY LIAISON COMMITTEE, NASA; ACCOMPANIED BY COL. D. L. LAY, W. H. GODEL, AND L. P. GISE

Mr. JOHNSON. ARPA has been assigned projects under three broad categories: Military space technology, propellant chemistry, and ballistic missile defense.

Mr. SISK. Mr. Chairman, is it necessary to take this down? I know we are recording this.

Mr. DUCANDER. Yes, Mr. Sisk, we usually take it. These are kept in accordance with official security rules.

The CHAIRMAN. What we do, Mr. Sisk, is Mr. Ducander takes the transcript, submits it back to the witness, and we delete what is secret and then if there is anything else that can be released to the public, it will be released, after it has been screened.

Mr. SISK. That is fine with me, Mr. Chairman. I just simply wanted to—I know I have some questions later on that are going to be dealing with a new proposed program that I understand is top secret and——

The CHAIRMAN. Go ahead, sir.

Mr. JOHNSON. Military space technology accounts for a significant proportion of the total ARPA effort.

In the early part of its existence ARPA was primarily concerned with the direction of scientific space endeavors, such as the Vanguard, and the Explorer satellites and the lunar probes. These projects were transferred to NASA in October 1958.

Now, a consolidation of our present military space programs, with funding, is shown on this chart.

The CHAIRMAN. The sum total is $331 million for 1958 and——

* * * * * * *

Mr. JOHNSON. Discoverer was separately identified in December 1958, and is designed to develop a number of systems and engineering techniques as well as provide component reliability measurements for new satellite vehicles.

The vehicle dimensions payload and funding are shown on this chart.

You will note here that Discoverer funding in 1959 and 1960 was roughly the same, and this, as I have said previously in open testimony, is the largest single expenditure within the military space program.

All vehicles to be launched in this program will be fired from the Pacific missile range. Later satellites in this program will contain biomedical experiments to seek data on environmental conditions which will be useful to the man-in-space program being carried out

jointly by ARPA and the National Aeronautics and Space Administration.

As part of this program, mice, and perhaps a small primate will be launched, and their recovery attempted.

The vehicles to be used in the Discoverer program consist of a Thor, first-stage booster, combined with an upperstage called the Bell-Hustler. Later phases of this program may use the Atlas booster for larger payload capabilities, and parenthetically later I would hope it would include the clustered booster.

The present schedule provides for the launching of approximately one vehicle per month, beginning this month. The date for launching now is the 25th of this month, next week for the first experiment, and continuing through the calendar year. * * *

The need for such a large number of launchings is predicated on the fact that the satellites will orbit for only short periods of time at relatively low altitudes. It is hoped that through this program an all-purpose vehicle with a wide range of application, covering a variety of military space payloads, can be developed and placed in space in stabilized condition.

* * * * * * *

Another important military space program is the communications satellite. The communications satellite program will provide vitally needed expansion of intercontinental trunking capacity together with greater reliability and speed of service.

Existing capacity is likely to be saturated within a decade.

The communications satellite offers the most promising answer to these extremely important problems. It is currently planned that the initial part of the communications satellite program will be the Courier delayed-repeater system.

Project Score, initiated in August 1958 and successfully accomplished on the 18th of December of last year, is dramatic evidence of the potential offered by orbiting communications relay systems. Score demonstrated the utility of putting into orbit communications equipment capable of receiving, storing and retransmitting messages. Since, through sufficiently high-flying satellites containing radio relay equipment, broadcasts can be made from a single point to half the earth, we can obviously help the military with all its communication problems under hot or cold war circumstances. A development program has been undertaken for the prototype of an operational delayed-repeater satellite communications relay system. This work is further refinement of the work initiated under Project Score.

The R. & D. system is to have a capacity equivalent to 20 continuously available hundred-word-per-minute teletype channels available at ground stations located around the world.

The transmission system will be capable of integration with existing communications systems.

Now, a later phase of the communications satellite program is the 24-hour orbit repeater. Here I parenthetically say we would have, I think, for the first time, the circular orbit which the chairman this morning discussed. It is the attempt here, and this is quite a sophisticated job, to get a truly circular orbit, 22,300 miles out.

This phase will provide satellites capable of receiving and retransmitting messages on an instantaneous basis from 6,000- and 19,000-

nautical-mile orbits. At the 19,000-mile height they will complete one revolution around the earth every 24 hours, hence their characteristic of maintaining position over a given point over the globe when launched equatorially.

For point-to-point service, the equatorial orbit appears to be optimum with three or four satellites equally spaced around the world.

* * * * * * *

The schedule for the Courier delayed-repeater system calls for initial tests in late 1959, this year, and early 1960. It is planned that operational tests will be initiated in * * * 1961.

The schedule for the higher orbit, real-time, repeater satellite calls for launchings in 1960 and 1961 of vehicles containing a nonoriented system, with limited operational capability for point-to-point or ground-to-air communication. Flights in 1960 and in 1961 will be made to develop the launching and the stabilization system.

Finally, there will be flights in 1962 and 1963 to test a stabilized, completely stabilized, 24-hour orbit and a satellite with broad-band communication equipment for point-to-point, ground-to-air and ship-to-shore capabilities.

This would be the ultimate sophisticated system, which I hope would be operational by 1963.

The presently planned programs for use of satellites for military communication purposes are based on active radio release. However, ARPA plans to follow the work of NASA and others in use of spheres or other types of reflectors, such as chaff, in orbit, or possibly passive repeaters.

* * * * * * *

Use of satellites for navigation amounts to a practical utilization of the satellite similarity of the stars. The important navigational difference, however, is that a satellite can be fitted with a radio source which can be heard or detected by any ship or plane, day or night, regardless of weather. This will be of particular value to combat aircraft and ships and ballistic missiles submarines and ships. * * *

The navigation satellite program is planned to provide an instantaneous, all-weather system for determining position at any point on the globe by passive means.

In principle, the receiving station will listen to radio frequency signals transmitted by the satellite as it comes over the horizon. This signal is initially shifted up by the Doppler shift due to the satellite rate of approach to the receiver.

The satellite will relay to the receiving station the signal for the Doppler shift, a coded signal of synchronous time and coded signal signifying the orbital diameters in effect.

By using this system, the position may be located within four-tenths of a mile.

As precise knowledge of the satellite orbit and times are known, accurate geographic positions can be determined.

The tactical cloud-cover satellite was undertaken as part of the navigational satellite program, with the objectives of investigating the utilization of television techniques in acquiring weather data. It is planned that the navigation satellite program will provide an answer to the present difficulties resulting from the lack of immediate weather information in inaccessible areas.

Three cameras, strategically positioned in the satellite, will feed pictures into separate magnetic tape recorders for playback when the satellite is interrogated.

The processing of this information will provide weather information. This is a more sophisticated version of the satellite that you discussed this morning.

A thousand pictures will be produced every 24 hours, each picture carrying its detail in 500 television lines per millimeter. This is far more sophisticated than the present television camera.

It is planned that four tactical cloud-cover satellites will be delivered by May of this year, plus six others to be used in laboratory environmental and other tests.

The first launching, with an estimated life of 5 months, will be attempted in July or August of this year, and the second in February or March of next year.

I have mentioned several satellite programs with dates of launching.

This chart is a consolidation of the programs.

Now, I would like to say this schedule may change as we investigate the development plans for various programs.

Mr. FULTON. Could I ask you, have you deep probes planned?

Mr. JOHNSON. No, sir; deep probes are a part of the civilian scientific oriented work, and we hope to gain the benefit of the knowledge acquired by NASA to use in our programs, but—well, I would like to say this, Mr. Chairman: In the military program I personally am concerned about the 600 miles above the earth, and at the moment I don't think that militarily we need to concern ourselves beyond 600 miles.

Now, this is a dangerous statement to make.

The CHAIRMAN. It certainly is.

Mr. JOHNSON. But I would guess that in time we will have to concern ourselves with the space outside of the 600-mile area, but for the immediate future, we are concentrating our effort in building military hardware to maneuver and to orbit in the first 600 miles.

The CHAIRMAN. What about the navigational satellite you just named, that will take an orbit of 18,000 miles?

Mr. JOHNSON. The 24-hour satellite will go out to the 22,000-mile area; yes.

The CHAIRMAN. You are not concerned with that?

Mr. JOHNSON. Well, yes. I am talking now about the basic work, outside of the 24-hour satellite, this is true, yes. The basic work will be in the shorter area beyond the earth's natural atmosphere.

This program here, you will note, builds up the payloads in successive—on a progressive time scale. * * * Obviously, as time goes on, there will be many satellites in orbit at one time. There undoubtedly will be many radiating as well as nonradiating satellites. For this reason, ARPA has been assigned the task of formulating a tracking and a data read-out system.

For radiating satellites and space programs, there is the Minitrack IGY network, a 60-foot antenna in Hawaii, which was built for the lunar probe program, and others in Hawaii and Vandenberg Air Force Base for the Sentry program.

Additionally, there is an 85-foot dish at Goldstone for lunar probe work and several research facilities, such as the Millstone Radar, the British Jodrell Bank Radar, have assisted us in other programs.

The IGY moon-watch organization is available on a worldwide basis and has a number of specialized telescopes. However, since moon-watch is limited by certain technical and weather factors, it was decided last June to modify and extend the Minitrack system to produce the capability of detecting, identifying, and orbit predicting nonradiating objects in space.

A Doppler system complex will operate in cooperation with Minitrack. Construction of a Minitrack Dopler fence across the southern United States is under completion. This fence, which is primarily for research purposes, has begun limited experimental operation, and data from the fence will be transmitted to a central station for reduction and transmission to interested agencies.

* * * * * * *

For the future, ARPA visualizes a need for a national space data coordination center which will serve the entire U.S. requirement. It would be responsible for categorizing all space vehicles. This program should also set broad goals for data acquisition as well as in data read-out analysis and dissemination, and parenthetically here is my personal opinion, that ultimately this center should be one to serve NASA, ARPA, any organization engaged in space activities and truly be a national center.

In order to assure a well-integrated system of facilities, equipment, operating frequencies, communications, nets, and so forth, required for an effective worldwide ground-based surveillance system, a decision was made in October to undertake a comprehensive study of the subject. In early January an agreement between NASA and the Department of Defense was reached on joint implementation and use of worldwide space tracking data acquisition and communication networks.

The tracking facilities of both agencies, planned or in being, will be used by the other agency until the load increases to the point where this arrangement is no longer practical.

A joint technical committee will monitor this program for the two agencies. To keep pace with the urgent requirements to place large payloads into orbit, ARPA has initiated the development, as I said yesterday, of a million-and-a-half-pound-thrust booster, using a cluster of available rockets. This is what it looks like.

This may be repeating information that you received at Huntsville. It was decided that pending development of a single-chamber booster of equal force, which is a long-term research and development effort, we should exploit the capability existing within the state of the art as rapidly as possible to meet immediate requirements.

To that end, the first major goal in this program is to demonstrate a full-scale captive test firing by the end of calendar 1959. Booster flights are to begin in September of next year, 1960.

In conjunction with the clustered rocket, ARPA issued a work order for the development program to provide a high energy, upper stage for us with the Atlas or the Titan.

The engine will use liquid hydrogen as propellants to achieve a nominal thrust rating of 35,000 pounds. This is the program we call Centaur.

* * * * * * *

There are other programs which ARPA is evaluating, one of which involves an electronic countermeasure satellite. Others can be grouped under the heading of "Exploratory Research" and include such items as recovery systems, power supplies, materials research, et cetera.

ARPA is interested in the man-in-space program called Mercury. In 1959 ARPA funded $8 million for this purpose, although we are not planning any funding in 1960.

Solid propellants constitutes a second category of ARPA projects. Solid propellants now available on the shelf are not high enough in performance to allow optimum design of ballistic missiles, ballistic-missile-defense systems, or other guided missile and space systems. ARPA has embarked on a major program in this area in order to bring about major improvements and advances in solid-propellant chemistry. The overall objective of this program is to discover new chemicals, the development of practical methods of synthesis and the knowledge required to utilize these materials in highly efficient solid propellants.

A major aspect of this objective is also the supporting research necessary to make effective use of these high-energy materials and propellants when they do become available. The initial objective is to make available for the development solid propellants having specific impulses 10 to 20 percent higher than now available. In order to achieve this objective ARPA has established four approaches. First on the basis of proposals from major chemical organizations, four contracts were awarded for comprehensive research endeavors in solid propellants. This work, broad in scope, involves ingredient synthesis studies, thermochemistry, thermodynamics and performance calculations, propellant formulation, property investigations, and necessary related chemical engineering and research.

Two, small industrial research contracts are also being sponsored with the intent to exploit some particular specialized skill on the part of the contracting organization in the field of high-energy ingredients and propellants synthesis, combustion, kinetics, and high-temperature tolerance of inert compounds, performance calculations, and the supporting research necessary to permit effective use of new high-energy materials when they become available.

Third, here the approach has been pursued through contracts with universities and nonprofit organizations. In this area ARPA is supporting basic research in the field of solid propellants to obtain information concerned with the necessary chemistry and physics for achieving the desired objectives. These studies are required since basic chemistry and thermochemistry of elements most likely to be used in high performance solid propellants are not today well understood.

Four, and finally, Government in-house programs have also been established. Work being carried out in these laboratories includes synthesis, engine-cooling techniques, detonation studies, thermochemistry, and new compound evaluation and characterization. These four

approaches are competitive in character with respect to the allocation of available funds. The overall objective is the discovery of new chemicals, the development of practical methods of synthesis and the knowledge required to utilize these materials in practical and highly efficient solid propellants. * * *

The third category of research assigned to ARPA is the defense against ballistic missiles. This program comprises all those advance phases of the ballistic-missile-defense program which are not included in the Air Force ballistic missile early warning system which we know as BMEWS and does not include the Army Nike-Zeus system. Our objective is to do those things which would make it feasible to build a defense of North America against ballistic missiles at greater ranges and from all directions.

Over the past several years there have been a number of elaborate studies of complete ballistic missile defense systems which have considered the detailed components necessary for detection, identification, tracking, and the kill of ballistic missiles. Without exception we believe that these studies have left as unknowns major questions concerning the actual characterization of the signals which would be obtained from the ballistic missiles flying above the atmosphere and then reentering the atmosphere. Also there are a number of unresolved questions concerning the feasibility of such things as kill mechanisms. For this reason the initial ARPA ballistic missile defense program is directed chiefly toward answering as many of these questions as possible, the area of research and funding for 1959 and 1960 being shown on this chart.

This is a little known fact in our concern over ballistic missile defense. I think this committee and the public at large is not aware of the fact——

Mr. McDonough. Can you enlarge this?

Mr. Johnson. No; I will read this. The fiscal year 1959 effort is $80 million. In fiscal year 1960 we propose to increase this to $128 million if the Congress approves our budget. * * *

The Chairman. Now, Mr. Johnson, I have asked the staff to prepare an analysis of just what you are giving us. Of course it will be confidential and private for the committee, but your people will work with our staff in getting that compilation.

Mr. Johnson. Mr. Chairman, we would be happy to, certainly.

The Chairman. One thing disturbed me a little bit, and I did not ask you, was the first chart there that showed an actual falloff in the amount of financial interest you have in the first chart which you gave us.

Mr. Johnson. At the conclusion of this presentation I would like to go back and refer to this chart. I did not pause sufficiently to point out that we are transferring several programs to NASA which account for part of the difference and then I am taking time out now to mention the fact that I hope that the fiscal year satellite program for missile defense will increase from the $18 million that you see here to a number larger than that by reprograming. I hope that it will be double this figure.

The Chairman. You are going back to explain the original charts?

Mr. Johnson. I would like to at the conclusion of this presentation; yes.

The CHAIRMAN. Just proceed.

Mr. MCDONOUGH. Mr. Chairman, a question.

The CHAIRMAN. Well, we thought we would wait until he was through.

Mr. MCDONOUGH. Well, it is a pertinent question to something he just brought out.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. You said this detection system would inform us, when it is operating in full, when the rocket is on the pad ready to be launched in Russia.

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The CHAIRMAN. Now the Chair will recognize Mr. Sisk and then we will go back to the program.

Mr. SISK. I did not quite understand your explanation as to why Nike-Zeus is not included in this program here, on this chart. You gave some explanation.

Mr. JOHNSON. I said Nike-Zeus is not an assignment of ARPA. ARPA has been assigned advanced research beyond the Nike-Zeus research.

Mr. SISK. Thank you. That is what I wanted to get straight.

Mr. JOHNSON. The first area of research phenomenon of ballistic missile flight is concerned with taking measurements on nose-cone reentry in the Atlantic missile range and the NASA range at Wallops Island. An example of this is Project Dam. This has instrumentation on a converted liberty ship, the *American Mariner*, which was launched recently for the observation of firings from the Atlantic missile range. It is being funded jointly by ARPA and the Army Nike-Zeus program.

Another program concerns the motor yacht *Acania* which has been equipped with a large variety of research radar and equipment. * * * This bears on the subject Congressman Fulton was discussing this morning.

Mr. Congressman, you were right at the heart of a very important scientific area. Research radars are also being installed at Wallops Island to observe small rocket firings and aircraft are being instrumented with optical and infrared instrumentation. All of these projects should give us a good picture of what atmospheric processes take place during launch and reentry of a ballistic missile.

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System components in which major state-of-the-art improvements are necessary include radar and data processing. In radar particularly it is considered necessary to develop high-capacity, high-resolution, high-accuracy systems of very large range. To be useful for ballistic missile defense, radars must have a very long range. * * * The laws of physics state that a 10-times increase in range requires a 10,000-fold increase in power of the radar. Thus, these radars are both very large and very powerful. As a consequence, they are also very expensive.

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In addition to radars, we are sponsoring a number of investigations in radar techniques. These include studies of ways to measure very small differences in distances while at the same time using very high

power, also methods of handling the tremendous amount of data coming from long-range radar * * * and which can distinguish between objects a few feet apart.

Now the data-processing problem includes a high-speed reduction of vast amounts of radar and other sensory data, calculation of trajectories, weapon assignment, transmission of data over large distances at high speeds, and AICBM guidance. One of the most serious phases of the data-handling problem is that of deciding when to release the defensive missile. Within a very few minutes of first warning a determination must be made whether an enemy attack is in process and carry out all necessary actions. The relations between machines and men under such circumstances is a very important part of the problem.

In addition to advanced defense against missiles, ARPA has the responsibility for defensive work against space weapons. Feasibility studies are now in progress on this problem.

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This completes the briefing. If you wish to, now we could return to the first tabulation chart.

The CHAIRMAN. Would you explain that first chart why the amount for fiscal 1960 is lower than fiscal 1959?

Mr. JOHNSON. Sir, I would like to point out in fiscal year 1959 we have $15 million for the tactical cloud cover, and this is being transferred to NASA and you will note therefore in fiscal year 1960 there is no money allocated to this project. You will also notice that the high energy upper stage, Centaur, which I referred to as being essential to go with the million-and-a-half-pound cluster if we are to get these high loads into orbit, is being funded at the amount of $16 million. This is being transferred to NASA at the end of the year. Therefore, the amount in 1960 becomes zero.

You will also note that in the manned satellite, the program called Mercury, we funded $8 million and this is being transferred to NASA with no funding for 1960. So if we add 16, 8, and 16 we come to $40 million of program being directed in the Department of Defense in 1959 and being transferred to the civilian agency. Therefore you should, if you want to make this comparison proper, either deduct $40 million from 1959 or add it to 1960, so the relationship would be more in balance.

The CHAIRMAN. There is a big difference in the first item, too, the Discoverer. Is that because that will be completed or nearing completion?

Mr. JOHNSON. The Discoverer program reaches its peak this year and begins to phase out as we learn more about the recovery techniques. The program then would become operational for other purposes and would phase out, that is correct.

The CHAIRMAN. So substantially the program is the same this fiscal year and next fiscal year with the exception that three of your projects are sent over to NASA.

Mr. JOHNSON. Leadtime, Mr. Chairman, has an important bearing on this. This is the money that we will commit in 1959. This does not necessarily mean that this is a measurement of the output. Mr. Gise, could you give us any idea what leadtime might be involved here

and the money that we will commit in 1959 but which will actually produce hardware in 1960?

Mr. GISE. It is 9 months at a minimum.

Mr. JOHNSON. The lead time is 9 months, so our effort in 1960 on that basis would be considerably greater than 1959.

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Mr. JOHNSON. * * * You see, ARPA is in the R. & D. business only. Once a satellite program or any program becomes operational, it will be assigned to one of the military departments for operation. * * *

The CHAIRMAN. Of course the military departments have the R. & D. program as well as the operational parts of the program?

Mr. JOHNSON. R. & D. in space is entirely in ARPA.

The CHAIRMAN. What about the Zeus program?

Dr. YORK. The R. & D. of the military space programs is entirely in ARPA. Nike Zeus is not a space program.

Mr. FULTON. Really, on your figure, the 1.5 million pounds thrust clustered engine that you have for fiscal 1959, the 23 million, the conclusion of your negotiations with ABMA will mean that will be revised as well.

Mr. JOHNSON. Yes; as I pointed out earlier in my presentation yesterday, we already decided to put $10 million into the million and a half pound cluster above the 23 million. My guess is we will put another $10 million at least to the $50 million in fiscal year 1960. * * * This is fluid. All I can do is report the status at the moment.

Mr. FULTON. On the $40 million the ABMA wants for the one and a half million pounds thrust clustered engine for 1959, could you correlate that figure for us on that chart to show what may be deducted from fiscal year 1960? How much will actually go in extra in 1959 and what might be deducted from fiscal year 1960?

Mr. JOHNSON. In 1959——

Mr. FULTON. How much are you moving ahead?

Mr. JOHNSON. We are moving ahead in that total column about $15 million, but some of this is coming out of the Secretary of Defense's emergency fund.

Mr. FULTON. I see.

Mr. JOHNSON. In 1960 if we can bring the program along to the point where we can sell the Secretary of Defense and Dr. York that additional funding is appropriate, it is hoped we would get additional emergency funds which we cannot now state because we are not far enough along in the art to budget it. But there probably would be additional money. * * *

Mr. FULTON. When Redstone and ABMA feel they are well treated—I think they do—the negotiations are going well and there is no dispute, and then they say they need the $40 million extra for fiscal 1959, what is the reason they are not getting the whole amount?

Can I have Mr. Quigley join with me on that one?

Mr. QUIGLEY. Yes; I would like to be associated on that question.

Mr. FULTON. Why are they not going to get the whole amount?

Mr. JOHNSON. The reason that there is an ARPA, the Secretary of Defense wanted to have one space program, not three. Each of the services has capabilities in narrow bands and the factories that

are associated could turn out a lot more hardware than might be intelligently used.

Mr. FULTON. So you do not want them to make the 16; you are going to limit them.

Mr. JOHNSON. I do not know how to use the 16, Mr. Congressman, and I have to have a few weeks.

Mr. FULTON. That is the nub of the question. They think they can use them and they are worthwhile and you disagree on a policy point, so it really is a determination of policy where there seems to be a disagreement of opinion between ABMA and Redstone on their R. & D. there with the policy group at ARPA and above.

Now I would like to have it not here but in the record sometime, why is that. I think Mr. Quigley would join in that, too.

Mr. QUIGLEY. Very much so.

Mr. FULTON. Because we were pretty well sold on the fact that they ought to have it.

Mr. JOHNSON. Well, I am not disagreeing with that, sir. The whole problem here is when ARPA decided we had to have a million and a half pound cluster, we got hold of General Medaris and Dr. von Braun, and said what can you do? They came back in 6 weeks with the proposal that we then bought and in August I had General Medaris in and I said "What is the fastest timetable that you can get us a minimum number of vehicles," and in the period to October, I believe it was, he came in with a program that I approved. I then said "Now what can you do to better this." I received the program on Monday. You saw it on Friday. What can I do between Monday and now? I am only told on Monday you see that he could better the program that he revealed to us in October, in response to my request. This is my request, because I visualized the 24-hour communications satellite. I visualized the other needs for this big booster.

Now they have said they can develop and they can produce within their facilities with a modest addition more launching vehicles than we had discussed. I have to now find out between us and NASA how can you intelligently in this time frame use the 16. It may well be that we can do that. Now they have ideas, of course, that are not military. * * *

Mr. FULTON. You see, when you limit yourself on policy to 600 to 800 miles above the earth's surface, that, of course, is a factor we had not known. So rather than have it get to where there is a "No" on the policymaking level in ARPA which shuts off these extra vehicles which can be used in the space agency, maybe we ought to be making a move in the NASA budget for the part you will not pick up.

Mr. JOHNSON. ARPA is not making any decision with regard to the total capability of Huntsville. They are presumably informing NASA of the same data they are giving us.

Mr. FULTON. Why do you not get in touch with NASA and between the two of you pick it up?

Mr. JOHNSON. This is a regular procedure with us. I am meeting with Dr. Glennan at 5 o'clock this afternoon.

Mr. QUIGLEY. Will the chairman yield to me for a comment so you will appreciate the concern of the members of this committee?

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Both General Medaris and Dr. von Braun indicated to me and to other members of this committee that, in their judgment, this clustered program was this country's best, and perhaps its only, bet to get to the moon ahead of the Russians.

Now rightly or wrongly as laymen, as representatives of the great mass of the American people, I think all of the members of this committee feel that there is a great importance psychologically, legally, in vast ramification of our getting to the moon first if we can. Maybe we cannot. But we feel that no stone should be left unturned.

Mr. JOHNSON. I happen to know, Mr. Congressman, that NASA is seriously considering this. As to the booster vehicle program, they are as intensely interested in it as we are, and they are planning to use it in their deep space probes. I suggest as to the probe question that the interrogation be of NASA. I have to point out that there is no military reason to send probes into the outer reaches beyond the area that I have described. We have no military reason for doing this. I agree with you, however, that——

The CHAIRMAN. But let me say this to you, sir: The information and the know-how that you achieve in a million-and-a-half-pound-thrust rocket will help you with your other programs; will it not? It will help you, for instance, with your Sentry program. It will help you with your communications program. It will help you with your navigation program; will it not?

Mr. JOHNSON. Mr. Chairman, this is the reason why we authorized it. This is the reason why, in August, we told Huntsville to give us a program to do this.

The CHAIRMAN. Well, now when they make a request for that additional money, it is true the request has not been here very long, but every delay in handling that request is going to have a direct effect upon the production of the completed product, and it is going to have a direct effect upon who is ahead in this race for control of space.

Mr. JOHNSON. Mr. Chairman, I would like, if I may, to get this in the proper context. The first four vehicles that they propose to deliver will not be speeded up by any more funding. The four vehicles that we have placed an order on will give us the earliest capability for putting these big payloads into space.

Their request for funding is incremental leadtime money to produce the other 12. I have had the request since Monday. We are now debating how we will use that.

The NASA is also studying this new availability which has been just revealed, and I am quite sure that between NASA and ourselves, payloads will be determined and that this funding will be forthcoming.

The CHAIRMAN. Could you let the committee know when you make a decision on that, to give them additional money?

Mr. JOHNSON. Yes, sir; I would be glad to.

The CHAIRMAN. We would be interested in the timing of it there and the result, too.

Mr. RIEHLMAN. Mr. Chairman, I think Dr. York had a comment he wanted to make here. He has been trying to get recognition.

Dr. YORK. I think probably Mr. Johnson has covered all of the points, but by last year's Space Act the responsibility for doing such things as getting to the moon was given to the NASA, so it is not quite fair to ask the Department of Defense why it does not take action to do that.

The CHAIRMAN. Then why, I will ask you, does Redstone still have that project if it has been given to NASA entirely? As I understand it, you are allowing the departments to continue with the programs that they had already begun. Is that not it?

Dr. YORK. No, sir; those programs that ARPA wants then the various military installations are to do.

The CHAIRMAN. Does Redstone still have that program of a million and a half pound thrust?

Dr. YORK. Yes, but not for getting to the moon, and that is what I understood the question to be, these extra boosters and so forth. ARPA does have the program; Redstone is carrying it out for the million-and-a-half-pound booster.

The CHAIRMAN. If they get the million and a half pound thrust and there are enough protoypes created, then we can use them for the purposes best adopted at that time?

Dr. YORK. But it is up to NASA to buy them and use them for that purpose.

Mr. FULTON. ABMA is the equipment supplier on that program.

Mr. SISK. Mr. Chairman.

The CHAIRMAN. Mr. Sisk.

Mr. SISK. I just wanted to say you are talking about Redstone having that program, but they are doing contractural work for NASA already and, of course, this would simply be—if NASA wanted to enter into a further contract for, let us say, four or six or eight of these vehicles, they would be in a position to do so, provided they had the funding to do it; is that not correct?

Mr. JOHNSON. That is correct. This is their intention, I am sure, and they have asked for a supplemental appropriation, and I believe part of this request is to cover this. This is again a matter of money.

I would like to point this out, though: I do not think the committee is clear that it was ARPA that conceived the idea of and the need for this program for a million-and-a-half-pound thrust. We are the ones that asked Huntsville to develop this.

There was skepticism in Huntsville. They wanted to engage in other booster programs beyond this. We sold them the idea that they had a unique capability to cluster the Redstones to do this job, and we have led this program.

We initiated it in August. We would not be where we are had not ARPA conceived this.

The CHAIRMAN. Let me say this to you, Mr. Johnson: I for one believe that ARPA is doing a good job and I recognized it because I carried over from my old committee assignment on Armed Services a good deal of the information that we have had here in this committee since.

Now, I don't want anything done to disrupt the program done by the Defense Department in the name of ARPA. On the other hand, the Redstone has that project now, and it seems to me everybody ought to get together and try to push it over and forget about petty differences as to whether or not ARPA has it, Redstone has it, NASA has it, or another agency has it. Is that right?

Mr. JOHNSON. Mr. Chairman, I assure you that there is none of that feeling. I would give an oath to that.

The CHAIRMAN. Fine, we will accept your statement there.

Mr. JOHNSON. There is no feeling of proprietary rights with regard to this cluster on the part of any of the three of us.

The CHAIRMAN. Now, are there any further questions there?

Mr. Mitchell?

Mr. MITCHELL. Mr. Johnson, as I gathered it, since the new Space Act, what it is you are saying is it is a question of whether or not it is proper under the laws that exist for Redstone, for Huntsville, to be asking you for this additional money rather than that they should be asking NASA for it. Is that right?

Mr. JOHNSON. No; not entirely.

Mr. MITCHELL. Since in your program you feel that——

Mr. JOHNSON. Well, the people of Huntsville understand perfectly well what the military requirements are. They understand what NASA is trying to do. I think the problem here right at the moment is the fact that since we issued the contract, we have done the funding to date, but they have chosen initially to convey this first message to us expecting that we would then convey it to NASA.

And I want also to make clear that what we got on Monday was not a technical program. It was merely a one-letter statement that in view of the changing situation they had in new capability.

We have now asked them for the technical backup. We are now giving this information to NASA. I am quite sure that you will find that if there is a requirement there that there will be no problem of their placing their orders directly in Huntsville for * * * their needs.

We know we have a need for four. The chances are that we will need immediately 4 more, as I said yesterday, and take 8 of the 16.

Mr. FULTON. So, really, who we pressure on this is Dr. Abe Silverstein?

Mr. JOHNSON. Yes; I think that would be a good idea. I want to see these 16 produced, too.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. Mr. Johnson, I would just like to clear up in my own mind something that you said; that you got a letter, that the letter was not a technical submission or proposition, and that you had to examine it from the technical viewpoint.

Aren't ARPA, ABMA, and NASA so coordinated that you know their capabilities to know the competency of the people down there, that every time they are going to come to you you have to make a deal and say: Wait a minute, we have to stand back and examine your technical competence to make sure what you are doing is what we want—is there that difference?

Mr. JOHNSON. No, Mr. Congressman, this is not a second guessing of their technical competency. This is an examinaton of what these satellites can do in terms of the kinds of payloads, the kinds of orbits, the distances out they can go.

You see, it isn't as simple as saying: Here is a vehicle composed of 2 or 3 stages that we can make available, because all of our missions are different.

I think you heard in the testimony this morning the technical problems of circular orbit, and we have to get this technical explanation of what kinds of payloads and what kinds of orbits they can achieve with this configuration. Then we have to decide if our payloads will match the vehicle.

Mr. MILLER. Then you are so far apart, isn't that a confession that there is a lack of interchange of knowledge or coordination, that you have got to go in and check one against the other in this field?

You know the chairman of the committee spoke of bringing information over from an old committee. I served with him on that old committee. One of the things that was always bothersome to us was trying to get the services together and to get away from service jealousies. It looks to me from the statement you just made, that this sort of thing is like saying: This is my little tower, I am not going to let anyone come into it.

And so, if somebody else comes to me and says: We have this capability, we can always hide behind the curtain, well, I haven't examined your technical competency to do this, when I was hopeful that in this new agency, with the pressure that is on us, we could get away from that. I was hopeful that you were close enough to know pretty well without the necessity, each time you wanted to buy a piece of hardware from an agency engaged in the same field, that you had to go through all of this technical submission of data that slows up the program.

Mr. JOHNSON. Well, I think the only answer to your question would be for you to interrogate Dr. von Braun and General Medaris, and ask if they have received prompt decisions from ARPA on submissions they have made.

I do believe it was reported back to me that these two men have so stated to this committee.

If a record was kept of that, I think that would be the fact, and if it hasn't been, I think the answer would be to summon General Medaris and Dr. von Braun to testify to that. They could give you a better answer than I as to the adequacy of ARPA responsibilities.

The CHAIRMAN. I don't think that is necessary, sir, if I may interpose there, because you are going to tell us when you make a decision on that. We will know from your own actions and your own statements.

Mr. ANFUSO. Would the gentleman yield?

The CHAIRMAN. Mr. Anfuso.

Mr. MILLER. I had the floor, but I suppose it is taken away now.

The CHAIRMAN. Mr. Miller.

Mr. MILLER. No; it is your's, you took it. I have no questions.

The CHAIRMAN. Mr. Anfuso.

Mr. ANFUSO. Mr. Johnson, I am a little worried about this use of decoys. A decoy would have to be a missile, wouldn't it?

Mr. JOHNSON. No; it could be just chaff. What they could do would be to explode the casing after the warhead was let loose and fragment it, and it would burst out into a mass of chaff. It would cover a large area, maybe a thousand pieces, and we wouldn't know by radar techniques which one was the warhead, and in order to get the warhead we might have to shoot and kill a hundred or a thousand objects.

Our problem is a very, very difficult one, if they threw a lot of chaff at us, on the radar screen they would all look alike. The profiles would be the same.

Mr. ANFUSO. Would it be a very expensive proposition, however, to use decoys?

Mr. JOHNSON. No; a decoy is a very inexpensive thing. You just put a little detonation in the casing and blow it up. It doesn't cost anything.

Mr. ANFUSO. May I ask Mr. Holaday a question now, or should we wait?

The CHAIRMAN. We are going ahead now, if there are any further questions, let's dispose of them.

Mr. ANFUSO. May I ask Mr. Holaday now, then?

The CHAIRMAN. Well, let's wait and let him testify. Mr. Sisk.

Mr. SISK. I had another program I want to question Mr. Johnson about. Is this the appropriate time to do that?

The CHAIRMAN. Yes.

Mr. FULTON. Before we start on a new line, may I clear up a question, with your permission?

Mr. SISK. I will yield to the gentleman.

Mr. FULTON. I believe we should say to Mr. Johnson that both General Medaris, as well as Dr. von Braun, have stated very definitely in my hearing the fine and hearty cooperation they have gotten from ARPA, from you, from Dr. York, and the whole crowd, and that there is really no dispute on it. And it was rather our questioning and our interest in trying to get the program moving fast that brought this whole thing up.

They were really not part of the movement on it and rather said, Well, hold back, and we said, Well, we will do it on our own, so there is no dispute as far as I saw it on the question by my good friend, Mr. Miller, as to whether there was such a dispute. There was no such evidence.

Mr. MILLER. Will the gentleman allow me to make a statement?

Mr. SISK. Mr. Chairman——

Mr. MILLER. You have the floor.

Mr. SISK. I will yield to you.

Mr. MILLER. I may say that I was not one of the party, to keep the record clear, who went to Huntsville and talked to Dr. von Braun or General Medaris on this subject, nor have I discussed it with them or heard it discussed in my presence. I want to keep that very clear. I am concerned, naturally, with trying to see that we don't get this thing into pigeonholes.

Mr. SISK. Mr. Chairman——

The CHAIRMAN. Mr. Sisk.

Mr. SISK. I wish to concur in the feeling that my colleague from California has about keeping down any controversy. I will at the same time say that I heard the same statement that my colleague from Pennsylvania indicated.

In fact, I think General Medaris had some hesitancy in even bringing this up, because he felt that the cooperation you had given him had been so good that he didn't want us to bring any pressure here, so you blame us for any of this, and we are not considering it pressure. We are just vitally concerned to see this program go ahead, as I am sure you people are.

Now, I want to discuss with you another program which I feel very strongly about, particularly as to the timing of the program, and that has to do frankly with certain geodetic surveys that I feel are important. In other words, it appears to me that failure accurately to

pinpoint military targets for our missiles would require a greater expenditure from our rather limited resources than possibly what we are doing to insure the destruction of the target.

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The CHAIRMAN. If you do not wish it to be recorded at all, we won't even have it taken down.

Mr. JOHNSON. I would like to have it not recorded.

(Discussion off the record.)

The CHAIRMAN. Are there further questions?

Mr. CHENOWETH. Mr. Chairman.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. I want to ask a general question as to the total amount you are spending in 1959 and the total amount you expect to spend in 1960, roughly, approximately. I am just curious to know. There seems to be some criticism we are not going fast enough. Will more money make us go faster, more accelerated, or what is the picture?

Mr. JOHNSON. As to the money, I am of the opinion that within the DOD budget we will find ways to reprogram close to $50 million in 1959 of new money for space work, I think as we are able to establish the need that there is going to be made available, as I said earlier, something like $100 million in 1960 of additional money over that which has been requested.

We cannot budget it now, because this is a very fluid situation, and I am not one that is going to advocate the spending—for example, there was a point here, a time a month ago when I was bent on spending $25 million on this satellite application. Then I did my homework and I found out information not available to me normally and not available to my staff. This information we now have. I could have very foolishly—as a matter of fact, I did ask for emergency funds of $20 million, and I have withdrawn it because it isn't necessary to proceed with this.

We can modify the Centaur to do it. I don't believe that just money alone is going to speed this up. We have to have a purpose with these satellites. We are not just putting them up there as basketballs. They have to have missions as far as the military is concerned. For science, I can't speak as to what you do with rockets for science.

Mr. CHENOWETH. I was thinking, Mr. Johnson, of the overall program. You were just talking about one specific program. I would like to know if you have the figures available what the Air Force, the Army, the Navy, all of them are spending?

Mr. JOHNSON. The whole program, yes, I believe it is adequate.

Mr. CHENOWETH. How much would it run?

Dr. YORK. About $800 million, including NASA.

Mr. CHENOWETH. Well, I have heard much larger figures than that.

Mr. JOHNSON. We are talking space only.

Mr. CHENOWETH. Missiles and everything.

Mr. JOHNSON. You are talking about the whole Defense Department.

Dr. YORK. Missiles and space together, $4 billion, I suppose.

Mr. CHENOWETH. I have heard 5½ or 6.

Mr. FULTON. The overall program is $6.7 billion.

The CHAIRMAN. Our committee checked it originally and they came to a military program of $5.5 billion and an overall program for all agencies of $7.1 billion.

Mr. CHENOWETH. That is for 1960?

The CHAIRMAN. Yes.

It is very difficult to figure it out, though. I will say this: what we want to get and our committee staff is working on it, is an analysis of the program from ARPA and from the military departments. We want to know exactly how much we are putting into research and development and in those departments.

Mr. JOHNSON. We will be happy to furnish that.

Mr. CHENOWETH. You have about four different groups here spending money.

Mr. JOHNSON. That is right.

Mr. CHENOWETH. Maybe it is five, you and NASA and the three military departments.

Mr. JOHNSON. That is five right away.

Mr. CHENOWETH. Is there more than that?

Mr. JOHNSON. The National Science Foundation and other groups spending money on research.

Mr. CHENOWETH. But not in the amounts you are spending.

Mr. JOHNSON. No, these are the big ones.

Mr. CHENOWETH. I would be interested in those figures, Mr. Chairman, when you get them.

The CHAIRMAN. When we have them worked up, they will be submitted to the committee on an executive basis, that is, a confidential basis.

Mr. CHENOWETH. I would like to say this, Mr. Johnson, in closing. I made the trip with the committee last week to Cape Canaveral and Redstone Arsenal. I was very favorably impressed with what I saw. I think you are doing a good job. As a layman and one completely uninformed on what I saw, my impressions were very favorable.

Mr. JOHNSON. We think this is the most competent group of people in the country, and we believe they are using their capabilities effectively.

We recognize the fact that they have productive facilities beyond what is being used. We would like to use them intelligently, but I for one am a taxpayer who believes that we shouldn't be doing this just because it is available.

We should have a purpose, and when those purposes are established and we can fund them, we will continue to use their capabilities to an even greater degree.

Mr. CHENOWETH. Well, it is something more than just spending money that is involved.

Mr. JOHNSON. Much more than spending money. I think we have become too enamored in recent weeks in trying to measure things in terms of spending money.

I have been guilty of waste myself, by being precipitous. I don't know how many millions of dollars of the taxpayers' money I have wasted by being precipitous.

Mr. CHENOWETH. Well, the general temptation is to move along faster than we have any right to express.

Mr. JOHNSON. There is, yes.

Mr. CHENOWETH. I think you are making pretty good progress, yourself.

The CHAIRMAN. Any further questions?

Mr. MILLER. I would like to make one statement off the record.

(Discussion off the record.)

The CHAIRMAN. Mr. Fulton.

Mr. FULTON. You people have spoken of the methods of intercepting or knocking down ICBM's or satellites. My feeling on it has been—I have been thinking about it a little bit—rather than trying to stop them or fragment them, why don't you boost their acceleration or just divert them? They may be easier to catch up with and just give them a push and that destroys their aim, than it would be to try to block them or fragment them.

Mr. JOHNSON. That is a good idea. I hadn't thought about that.

Mr. FULTON. The question comes up where there is no atmosphere or anything which would respond to a detonation or impact. Possibly we are on the wrong end of it. We should perhaps chase them and increase their acceleration or velocity when they start, than to try to knock them down when they are coming in.

May I say to you if you know where the installations are, you get a very much narrower arc of initiation than you do of reception, and it is a much smaller problem.

As a matter of fact, when you are catching them on the upgrade, you then chase them into the apogee rather than have a blank space and then try to receive them with those advanced radar receptions.

Mr. JOHNSON. The ideal way, as I pointed out in my presentation, is to invent a death ray which you just point; and explode them.

Mr. FULTON. You are more advanced than I. When the Russians have already had a scientist announcing a program for putting an unmanned tank on the moon 8 years ago, why do you people abandon the strategic area of the moon when as good an authority as General Boushey of the Air Force believes that that is part of our strategic defense?

Mr. JOHNSON. I haven't a requirement from the Joint Chiefs of Staff which tells me we should begin to deploy military vehicles to reach the moon.

Mr. FULTON. You do not, or you do?

Mr. JOHNSON. We do not.

I think at this point in time, it is the intention of the Space Council and the decision of the President who transferred the moon shots from ARPA by Executive order to NASA. This was a clear intention that probes in the area of the moon were to be civilian conducted, and the Congress did set up the Space Council to make these decisions. The Council recommended them to the President and these decisions are his, not mine.

The CHAIRMAN. Now, if there are no further questions, I would like to ask a couple of questions.

A U.P.I. dispatch of February 15th quoted Dr. York as stating that the Defense Department may soon reconsider its decision against starting early production of a missile designed to shoot down enemy intercontinental rockets.

That is correct, isn't it?

Dr. YORK. I don't know where I—I am afraid I am lost. Where did they quote that from?

The CHAIRMAN. Dr. Herbert York. The date is February 15.

Dr. YORK. I have no question, I am just trying to think of where on earth they would have gotten the information.

The CHAIRMAN. They quoted you twice there as giving consideration on that.

Mr. JOHNSON. This is "Anti-Missile Decision Soon Under Nike-Zeus."

Dr. YORK. I don't know where it could have come from. Would you like to ask me some specific question on that?

The CHAIRMAN. It came from U.P.I.

Dr. YORK. But where did U.P.I. get it? Do you have some specific question in mind concerning that?

The CHAIRMAN. Yes. That program interests me very much, because, according to this article that I have here by Brig. Gen. S. M. Melnick, in El Paso, he says—I won't read the whole article, it is a full page—he says that the Nike-Zeus is simply a projection of the Nike-Ajax and the Nike-Hercules, simply speeding up the missile and making it a little larger missile. And he says that the Nike-Ajax and the Nike-Hercules are so effective that the Army has run out of targets in El Paso, there is nothing more to shoot at, and they have to create an error in the Nike-Hercules missile they send up to keep the Nike-Hercules missile they send up from destroying all of the targets. Otherwise, the Air Force will run out of targets to furnish them. He is a little bit optimistic, I believe.

Dr. YORK. I won't argue with the general.

The CHAIRMAN. He refers to the Hawk there, and its capabilities, but the main thing I am interested in is the Zeus. He says it has the same qualities as the Hercules, which has been so immensely effective. I want to know, considering that fact and knowing that the Zeus offers us the only possibility that I see at the present time of bringing down ICBMs after they are launched from Russia and before they are detonated in this country, if you weren't correct when you were quoted as saying you were going to reconsider that program?

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Mr. MCDONOUGH. Well, this ray defense that you spoke about, Mr. Johnson, is that just Buck Rogers or is it real?

Mr. JOHNSON. At the moment it is pretty much Buck Rogers, that is, report. We are sponsoring and financing some work in several areas, some of it theoretically is looking more hopeful as the days go by. But it is this kind of breakthrough that is going to solve this kind of problem.

I think in the time span between now and 1966, we could hopefully expect such a breakthrough. I am not saying a ray, but a breakthrough for a defense against missiles. I don't know what it would be.

Dr. YORK. The best way to produce such a breakthrough or to come across something is to keep working on it in a fairly active way. That, incidentally, is how the hydrogen bomb came about. For the first 2 or 3 years of work on the hydrogen bomb, the situation was that it was possible to prove, as I have sort of attempted to do here, that it couldn't be done, and in fact, the designs that people were spending all of their attention on in those days and the ones all of the calculations were being made about, we now know indeed they would not have worked, but it was through assembling people and having an

intensive effort on this kind of system that the workable hydrogen bomb came about, and essentially we hope the same sort of thing somehow is going to happen here; that by keeping a good active pressure on this, that we will find out a way to get around these problems that I spoke of.

Mr. McDonough. We beat the Russians on that, didn't we?

Dr. York. Yes, by some.

Mr. McDonough. We were ahead of them by how long on the H-bomb?

Dr. York. Even that is an arguable point. I would put it, on one of reasonable efficiency, a couple of years. It is a fact that they exploded one within about 10 months of the time that we did, but there was quite a difference, even so, in just what those were like.

The Chairman. Now, before we go too far here, Mr. Holaday, do you have a statement?

Dr. York. He has stepped out for a minute.

The Chairman. Does he have a statement?

Mr. Holaday. No, sir.

The Chairman. We caused you to stay over, and we don't like to inconvenience you. We want to conclude this part of the hearings this afternoon, if we can.

Do you have a statement?

Mr. Holaday. No, the statement we gave yesterday morning is all I have. I was here to answer questions.

The Chairman. Mr. Fulton.

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Mr. Chenoweth. Mr. Chairman.

The Chairman. Mr. Chenoweth.

Mr. Chenoweth. I would just like to ask another general question of Dr. York and Mr. Johnson. We hear so much discussion and speculation as to who is ahead in this race and just how far Russia is ahead of us or whether we are on a par, how fast we are catching up, whether they are slipping. What is the best information that you have?

Dr. York. If you are talking about military posture as a whole——

Mr. Chenoweth. Take the military first.

Dr. York. But military now, and not missiles, but the total posture——

Mr. Chenoweth. As it relates to missiles.

Dr. York. The total posture, it is our conviction that we are ahead, in total military posture. I am not just talking about missiles or space, either. I am talking about everything. As far as missiles are concerned in terms of research and development, we probably are somewhat behind.

Mr. Chenoweth. What do you mean now we are behind, how far behind?

Dr. York. A missile is so complex, it consists not only of propulsion, but guidance, control, warhead, reentry body, and also what is more difficult to measure, experience, which has to do with reliability; that you cannot just put a date on it, but in propulsion the evidence as far as I am concerned is that the Russians are positively ahead.

On these other things I think they are probably not. How to balance all of this I do not quite know except to say that I think we are behind.

Mr. CHENOWETH. Are we getting any information out of Russia that is of any value to you in appraising the situation?

Dr. YORK. Yes, we get information of value in appraising the situation.

Mr. CHENOWETH. Is it all classified or could it be revealed to the committee?

Dr. YORK. The CIA does have a briefing, I believe.

The CHAIRMAN. We are going to have the CIA later on.

Mr. CHENOWETH. Well, you do feel satisfied, Doctor, with the progress we are making now in this race?

Dr. YORK. In the field that I am involved in, which is research and development, by and large, yes.

Mr. CHENOWETH. Well, I am glad to get that.

The CHAIRMAN. Doctor, would you say that Dr. von Braun was incorrect when he said that the Russians were a year ahead of us?

Dr. YORK. No, except I find it hard to use that kind of measure of saying a year or not. I do not feel that is in error, I just feel it is an oversimplified way of answering the question. I do not think it is wrong.

The CHAIRMAN. Well, if there are no further questions——

Mr. MITCHELL. May I ask just one more?

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Since Mr. Holaday has been in, I do not think a question has been directed to him. I think he should have at least one today, so, Mr. Holaday, I will ask you if you had a recommendation last fall, I believe that was in your agency and you were concerned with it, concerning Nike Zeus and production—did you make a recommendation to go into production or not?

Mr. HOLADAY. The Nike Zeus study was made by the committee on which Dr. York was a member. They reported to our committee and it was our recommendation which went up and became part of the action of last fall. It was explained by Dr. York to you that other people put their considerations into the recommendation and that the JCS also recommended, except for the Army member, that Nike-Zeus not go into production.

Mr. MITCHELL. Then you followed the approval of the two who recommended production last fall?

Mr. HOLADAY. Yes. I am wondering, though, if you are asking the same question.

Dr. YORK. He did not recommend production.

Mr. MITCHELL. I realize he was not on that study group. But were you called upon to make a recommendation?

Mr. HOLADAY. No, I was not called upon to make a recommendation at that time.

Mr. MITCHELL. Did you make one?

Mr. HOLADAY. Yes, sir.

Mr. MITCHELL. What was it?

Mr. HOLADAY. Then I assume you are going back to the letter which got into the hearings in the Senate. There is a letter which I will be glad to make available. I will read to you what it says about Nike Zeus at this time because this is a classified meeting—this is a classified piece of paper. Would you like to have that recommendation?

The CHAIRMAN. Go ahead and read it.

Mr. HOLADAY. On Nike Zeus, while I concur in maintaining the Nike Zeus program at an R. & D. level, I believe that $40 million should be added to this program, $300 million plus $40 million, a total of $340 million, to permit engineering development work on certain pieces of mechanical equipment, such as machines to automatically produce transistors and resistors as part of our development program. This will give us assurance that equipment of this type can be developed and establish a better understanding of the total effort required to reach a production level.

The CHAIRMAN. In other words, you recommended that they go ahead with it?

Mr. HOLADAY. No, sir; I recommended that a certain amount of money be put in here to go ahead with the development of these automatic machines. It was a lead-time proposition to see if the machines can make them. This is quite an important phase here, because if we are unable to develop these automatic machines to make transistors and resistors the country just does not have enough billions * * * to make these by hand. This is a phase that we will have to find out. This is one of the very important engineering phases of this program.

The CHAIRMAN. Well, that is where the Army got the figure of $40 million?

Mr. HOLADAY. I do not know where the Army got that.

Mr. RIEHLMAN. Mr. Chairman.

Mr. MITCHELL. He has offered that letter for the record. I would like to have it inserted.

The CHAIRMAN. Do you have any objection to putting the letter into the record?

Mr. HOLADAY. No, sir; not if you ask for it.

The CHAIRMAN. It is a classified record. No objection, it is so ordered.

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Mr. CHAIRMAN. Mr. Riehlman.

Mr. RIEHLMAN. I had a group of questions I anticipated asking Dr. York in the open session. I did not get the opportunity. I left before the meeting closed. I would like the permission to present him with those questions dealing with his new authority and direction over his whole program, which I would like to have made a part of the record. I think they are important.

The CHAIRMAN. No objection, so ordered.

Mr. MILLER. A part of the open record?

The CHAIRMAN. No; the classified record.

Mr. RIEHLMAN. It will not deal with classified subjects, so it could be in the open record.

The CHAIRMAN. If there is no objection, it will be placed in the open record. Of course, Dr. York's answers he can so frame that they will not be classified.

Mr. RIEHLMAN. There will not be anything that will hinge on secrecy.

The CHAIRMAN. Any further business? It is 4:30.

Mr. MCDONOUGH. Mr. Chairman, a question off the record but rather pertinent.

(Discussion off the record.)

Mr. FULTON. I would like this on the record.

Mr. MCDONOUGH. I do not want it on the record.

Mr. FULTON. Then I do not think it should be asked.

Dr. YORK. Decisions of this sort would normally be made by the agencies actually planning the program, which means by one of the services or ARPA rather than someone like myself on the Secretary of Defense's staff. I suppose a situation would develop where I would have to get into it, but normally this is a matter that would have to be taken up by the services or ARPA.

Mr. FULTON. How is this political rivalry developing between New York and California, may I ask the members from the respective States?

Mr. MCDONOUGH. It developed evidently as a result of some influences in the State of New York asking for a greater share of military contracts over the ones in California.

The CHAIRMAN. I think we have gone far enough into this.

If there is nothing further, the committee will stand adjourned.

(Whereupon, at 4:32 p.m., the committee recessed.)

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MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Tuesday, February 24, 1959.

EXECUTIVE SESSION

The committee met at 10 a.m. in executive session in room 356, Old House Office Building, the Honorable Overton Brooks, chairman, presiding.

The Honorable Allen W. Dulles, Director of the Central Intelligence Agency, and his associates briefed the committee on various aspects of the Soviet missile and space programs. All proceedings were off the record.

The committee adjourned at 12:15 p.m., until 10 a.m. the following day to consider another subject.

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Monday, March 2, 1959.

The committee met at 10 a.m., in the caucus room, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The CHAIRMAN. The committee will please come to order.

This morning, gentlemen of the committee, we have two important witnesses here before us. We have the privilege of having for the first time the Secretary of Defense, the Honorable Neil McElroy, and we also have the pleasure and privilege of having before us the Chairman of the Joint Chiefs of Staff, General Twining.

I would say to the members of the press: If you still want to take more pictures we will give you more time but the rule is, of course, that after the committee gets underway there will be no pictures taken. That is the rule of the House, so I will ask you before we get started to complete your picture taking so we can go ahead.

All right, everybody seems to have the pictures he wanted, so, we shall proceed. Mr. Secretary, the Committee on Science and Astronautics has been working for several weeks on hearings regarding the development of space possibilities. Within those hearings we have especially concerned ourselves with missiles and particularly with ballistic missiles. There is some concern in the committee whether the matter is being pushed with utmost vigor and whether we are pursuing the right policies, so we are especially pleased to have the benefit of your judgment, your experience and your position to fortify the committee on this occasion.

You have a prepared statement and we would appreciate it if you would proceed with the statement.

Secretary MCELROY. Thank you very much, Mr. Chairman, and members of the committee. My statement is quite brief. I will read it if that will be satisfactory.

The CHAIRMAN. Surely.

STATEMENT OF HON. NEIL H. McELROY, SECRETARY OF DEFENSE

Secretary MCELROY. I welcome this opportunity to appear before you, along with General Twining, and answer to the best of my ability questions you may have regarding the missile and space programs of the Department of Defense. We share with you a conviction regard-

ing the importance of our activities in this field; in fact we are convinced that the future security of the Nation depends on our skill in moving forward our capabilities not only in these vital areas but in the many other fields embraced by the interest of this committee.

Many of the specific matters regarding our missile and space programs have already been taken up with such highly qualified individuals as Dr. York, Mr. Johnson and Mr. Holaday. You may have some questions to ask me on these programs, but before we turn to such questions I believe it might be helpful for me to state in a few words the way in which our Department has now organized itself to carry out our responsibilities in research in general, which includes our military and space programs.

As you know, one of the most important objectives of the recent reorganization of the Defense Department was to insure that our research and engineering activities would have the integrated direction and leadership needed for our national security now and in the future. To this end a new position was created, that of the Director of Defense Research and Engineering, and Dr. Herbert F. York has since been appointed to occupy that position. The Director of Defense Research and Engineering is my principal adviser on scientific and technical matters and is responsible for the supervision of all research and engineering activities in the Department of Defense.

The interrelationship of the Director's activities with those of other elements of the Department of Defense can best be understood if we look at the whole operation. There are four basic operating research and engineering agencies in the Department of Defense: Army, Navy, Air Force, and the Advanced Research Projects Agency. These agencies do research and engineering of a varied nature consistent with their assigned duties. The research they undertake may be done within their own facilities or by contract with outside sources, depending on which in their judgment will produce the best results. The function of the Director of Defense Research and Engineering is to supervise and coordinate all research and engineering, regardless of what element of the Department of Defense does the work or the nature of the work undertaken.

I look to the Director to provide the dynamic leadership which will see that our research and engineering programs are far reaching and imaginative, move forward without unnecessary duplication, and represent an optimum integrated program to meet the requirements of national military objectives.

With respect to the Advanced Research Projects Agency—we plan to continue this Agency as an operating element paralleling the research and engineering organizations of the military departments. The Director of this Agency will report to me administratively in much the same manner as the military departments do. However, as I stated previously, his research program will be subject to the supervision and coordination of Director York's office just as are those of the military departments.

With respect to the Director of Guided Missiles, his responsibilities formerly had two different aspects. One has been to monitor and supervise all research and engineering work in the field of guided missiles; the other has been to keep me informed of any impediments in these high priority programs which I as Secretary might expedi-

tiously help to remove so that maximum progress might be achieved. The research and engineering duties of the Director of Guided Missiles together with personnel involved will in the near future be transferred to the Director of Defense Research and Engineering. This transfer will be made in a way which will insure no loss of the momentum our missile program has developed. Mr. Holaday will, for an indeterminate period, remain as a special assistant to me to continue to handle those aspects of the guided-missile program which are beyond the research and engineering and testing phase in addition to his duties as Chairman of the Civilian Military Liaison Committee provided for in the act establishing the National Aeronautics and Space Agency.

I believe this represents a sound organizational framework within which we can move forward with an aggressive effort in the fields of this committee's interest to insure the defense of this country—recognizing, of course, that it is men not organization which produce final results.

I should be happy to answer any questions the committee may have. Thank you.

The CHAIRMAN. Thank you very much, Mr. Secretary, for your statement. I would like to ask you this in line with your statement: Dr. Herbert York now is the man with authority to make decisions with reference to guided missiles, ballistic missiles, and generally that type of work, is that correct?

Secretary MCELROY. The research and engineering aspect, yes, sir.

The CHAIRMAN. He has full and final authority, subject, of course, to your supervision to make these decisions, and if there are any delays in decisions in the future, the responsibility lies at his doorstep for delay and if they are properly and promptly made he is entitled to all of the credit.

Secretary MCELROY. Yes, as to engineering and research.

The CHAIRMAN. And subject to your authority as Secretary of Defense.

Secretary MCELROY. Yes, and it is also my responsibility if it does not go correctly.

The CHAIRMAN. But he is responsible directly to you. He does not go through any other channel or medium in order to reach you if there is any question about his decision?

Secretary MCELROY. That is correct, sir.

The CHAIRMAN. And the agencies below him will go direct to him for the determination of vital questions?

Secretary MCELROY. That is correct.

The CHAIRMAN. What I am leading up to is this Nike-Zeus matter. One of the members of the committee, Mr. Teague of Texas, has suggested, and I think it is a very relevant suggestion he has made, that I ask you to simply explain in detail in your own words, if you will—because you do not have it prepared in the statement—what the situation is in reference to the defense of this country against ballistic missiles.

There was an article in the press this morning, for instance, that worried me a great deal, about the fact that we were not prepared as a nation to defend ourselves against ballistic missiles and in fact we

were not prepared to know when ballistic missiles even were being used until they arrived in this country.

Secretary McElroy. As of the present it is true that we have no defense against ballistic missiles. The program which is expected to be in position and operating in time to give us warning of the launching of any substantial number of ballistic missiles in this direction is the Ballistic Missile Early Warning System which is nicknamed BMEWS. This is moving forward on a very high priority basis. There will be one detecting station in Greenland—it is under construction—one in Alaska, and there will be a third someplace in the British Isles, after the proper negotiations are carried on with the British Government. It is expected, however, that the important area that needs to be scanned will be coverable by the Greenland and the Alaska stations and they will be in place and operable within the time period that we expect that our potential enemy may have sufficient number of missiles to be a real threat to this country. As far as actual spot defense of the type that will knock down missiles, we are working under the highest national priority in the research and development aspects of the Nike-Zeus system as the system on which we have placed our bet as the one which has the best prospects for a moderately early operational capability.

But that is still several years away. The defense of this country against ballistic missiles for some period of time to come will have to be a capability offensively to respond with such tremendous destructive power to any attack on this country by an enemy that the potential enemy would not in his own interest initiate any attack against this country, because we do not visualize for some years having specific defense against incoming ballistic missiles. We have no assurance that even if we had in place a ballistic missile defense system we would be in a position to knock down any more than a modest percentage of any mass attack by an enemy with ballistic missiles.

The Chairman. Well, Mr. Secretary, for the time being I think most experts agree that we are reasonably safe because Russia does not have the capability at present, so our people feel, to launch a mass ballistic missile attack against this country. But as you move on and the capability is developed, are we in turn moving on to develop a defense against an aggressive capability of a foreign power? What I am referring to specifically is the Zeus program. You say it is being pushed with utmost priority in the research and development stage, but that is going to require several years. That being the case, when it is perfected and you are ready to put it on the assembly line you have a time lag again, have you not?

Secretary McElroy. After you are clear as to just what your various components are going to be, it will take some time to put yourself in a position to produce these in the very large numbers that will be required.

The Chairman. That is what I am getting at. Is there a way to lessen that time, even if you are taking a calculated risk? Is there not a way to eliminate some of the time lag so this country will be in a much better defense posture at a much earlier date than you plan in the Pentagon now?

Secretary McElroy. Well, one of the things that we propose to do, Mr. Chairman, and it is under intensive study now, is to try to develop—and this may require a rather comprehensive engineering study—either inside or outside of the Department, ways in which we can kind of preplan production prior to the freezing of design of various components. We are not in any position to freeze design at this point in the opinion of our scientific advisers. But as of the time that we are ready to freeze design and go into production we are now looking very intensively at the ways in which we might do the kind of preplanning that would shorten the time between that freezing of design and the actual turning out of substantial quantities.

The Chairman. Can you not at this point begin your planning toward ultimate production of the Nike missile, assuming it develops all right?

Secretary McElroy. Well, we think we should do planning. The thing that we do not think we should do is to build plants and do tooling, when we do not know what we want to produce or the type of design of these very highly advanced kinds of components. The reason for the hesitation in going into production or actually producing plants for production is solely that these are not sufficiently clear to the scientists as being effective components for the job that has to be done to warrant going into the production stage.

The Chairman. It has been testified before this committee that the sum of $40 million is sufficient for the next 12 months to go ahead with your preplanning on the possibility of ultimate production. Could you not go ahead with that expenditure—I recognize that is a calculated risk, if the Zeus does not pan out, the money is lost and the public ought to know it in advance; and it is a calculated risk in the use of the money. Could you not go ahead with a program of preplanning for production and then, say at the end of another 12-month period, reappraise the situation before you go into large-scale spending on actual production? I think they testified the second year it would cost $700 million in planning for production.

Secretary McElroy. The thing which you are suggesting is the thing which is under study at this time. Whether we need to spend that amount of money I do not know, but what we will do is see if there is any preplanning that can be done. We will do this, again, under the best scientific advice that is available to us. And I will say to you, Mr. Chairman, that the best scientific advice in the country has been put against this program because of its obvious importance, which we recognize as well as this committee recognizes, and if there is any preplanning which can make any sense from the standpoint of shortcutting toward ultimate earlier production, that we will want to do. It could very well be, if your committee would like to have us do so, we will keep the committee informed as we go along with this study.

The Chairman. The committee would certainly appreciate that, Mr. Secretary, very much, because they are concerned. For instance, I read this morning in the press an article by Mr. Alsop in reference to his view. For instance, 150 ICBM's launched from Russia might wipe out completely our retaliatory force. Right now, parenthetically, I would like to put in a good word for the Air Force for the magnificent job SAC is doing now to set up that deterrent force.

But assuming that this writer is correct and that 150 ICBM's launched from Russia might completely wipe out our deterrent force, then we have nothing. We have no deterrent, and we have no defense against the ICBM.

Secretary McElroy. The only part of your statement to which I must take exception is the first five words, the introductory statement, "assuming the writer is correct." We think the writer is incorrect.

The Chairman. There is some question about the ability of our people to know in advance what the Russians are going to do and to be able to meet it offensively by meeting defensively the ICBM attack.

Secretary McElroy. Well, Mr. Chairman, there is no question at all that when we are thinking of survival we must be extremely conservative in what we do. This committee feels that way and so does the Department of Defense. We must not take these matters lightly. This entire subject, as I am sure you would realize, has been given review not once but many times, and it will be given in the months to come review and review and review. We believe we are acting in the conduct of our military affairs on the basis that provides a cushion for the national security and I mean a considerable cushion, which we should do. Now when you start making assumptions about enemy capability which are greatly in excess of what is calculated to be the enemy capability by the best intelligence sources available to the country—and there can be no better sources of intelligence to anyone, whether he be a writer or whether he be this committee—I think we have no real basis for conducting our affairs except within what seems to be the limits of conservative interpretation of those intelligence statistics and that is what your Defense Department is doing.

The Chairman. I think that is an excellent answer but I would call to your attention this, Mr. Secretary: Somewhere down the road the Russians may have that capability and at that time would we be in shape with a defense such as we hope the Nike-Zeus to be, in production, to meet that threat. That is the thing that concerns me personally and, I am sure, many many Members of Congress.

Secretary McElroy. I think for some time to come, Mr. Chairman, our defense against incoming missiles will have to be the maintenance of an aggressive position to destroy anyone who sends these in on us. Our defense under the optimum conditions with Nike-Zeus would not be ready and in place in the time period in which we would expect the enemy to have a substantial number of ICBM's in place. So our deterrent must be an offensive deterrent, and the kind of thing, such as an air alert, that could very well be added to give us a greater defense capability as the months and years go by and we grant him a greater missile capability.

We now have a ground alert for one-third of the force because the Joint Chiefs of Staff regard that as the type of alert for which we currently have a military requirement. As of the time that the Joint Chiefs of Staff consider that we have a military requirement which involves air alert of a certain share of our SAC bombers, we will have air alert. We have experimented with it and we know that we can do it but there is no reason to put this kind of very rigorous requirements against both equipment and men until you need to.

The Chairman. Well, do you not feel that anything that can reduce our time lag on the development of a Nike-Zeus type of defense should be adopted by the Defense Department?

Secretary McElroy. I do, sir, and this is implicit in the development of the program on a top national priority basis. This is true of very few of the programs that we have. It includes our Atlas. It included Thor, Jupiter, Polaris, and there may be one or two others but it does include Nike-Zeus. This is a priority which is established, as you know, sir, by the authority of the National Security Council, and this priority is held by the Nike-Zeus development.

The Chairman. And in the event our deterrent fails and the unthinkable does occur, that is war, we have nothing to offer better hopes of defending our shores against the ICBM than the Nike-Zeus at this time.

Secretary McElroy. We do not. We have placed our bet on the Nike-Zeus system. We have at the same time, however, a program in the Advanced Research Projects Agency which permits the Army to go down the direct development road while over in the Advanced Research Projects Agency we are already working with a very substantial program. In 1960 it will be over $100 million for the development of advanced techniques, particularly in the area of discrimination between the incoming warhead of an ICBM of an enemy and any decoy material that he might throw into the air to confuse your radars or your antimissile missile as it moves out to intercept.

The Chairman. One more question and I am through. Then, as I understand it, are you prepared to go ahead and authorize preplanning on the Nike-Zeus production program at a relatively inexpensive beginning?

Secretary McElroy. I am, sir. This may not be precisely the thing that has been said to this committee in the past by other witnesses. I do not know precisely what was in mind.

The Chairman. As a matter of fact, they told us there was a division of opinion on that and therefore I thought it was something that the committee could well take up since there was a division of opinion.

Secretary McElroy. I will only say to you, Mr. Chairman, as late as this morning in anticipation of my appearance before this committee, I have had confirmed again that this study of the method by which we could best preplan production as a means of shortcutting the time between the freezing of design and the actual mass production of components is a study which is actively being pursued in the Department of Defense Research and Engineering, under Dr. York.

The Chairman. Well, is there still a division of opinion about that?

Secretary McElroy. I cannot tell whether there is a division of opinion until this part of the Department comes out with its recommendation. I think there may very well be a difference of opinion as to how to proceed, that is, just how to proceed with the preplanning.

The Chairman. Well, has there been a difference of opinion?

Secretary McElroy. It has not come to me, Mr. Chairman, if there has been. I am sure that there are differences of opinion on quite a few things down below me, but they ultimately come to me if they are really of importance.

The Chairman. Well, if the Army recommended a speeding up of the production program, or beginning of the production, it has not come to you and you have not passed on it?

Secretary McElroy. Well, I am aware of the fact that the Army did want to go into production as part of the 1960 budget. That part I am quite clear on. The Army wanted a substantially higher expenditure and the expenditure beyond the amount that is included in the 1960 budget, which is $300 million to the Army, was for the purpose of building factories and doing some tooling. Now that did come to me and the decision was made by me not to go ahead with this, and this was on the best scientific advice that I have available to me. This is not only my advice but it is also the advice that is available to the top administrative levels. But the thing that I take it you and I am now discussing, Mr. Chairman, is some interim step which is: If we do not immediately go on with the production of factories and tooling of factories, is there some way in which we can do some planning for that, so that we can reduce the time required to move in that direction once a freezing of design is possible?

The Chairman. What we are discussing is those methods which can be taken with a reasonably calculated risk which will reduce the ultimate time lag to put this country on a defensive basis against the intercontinental ballistic missile.

Secretary McElroy. I can tell you that I am very much interested in this personally and I intend to pursue it in order to get a specific proposal from our Research and Engineering Department and then we will move toward a decision.

The Chairman. Mr. McCormack.

Mr. McCormack. Well, Mr. Secretary, what you have said in substance is that our whole military position is predicated upon the policy that under no conditions will we attack first.

Secretary McElroy. Our policy is that we will not attack first, Mr. McCormack.

Mr. McCormack. Rather an untenable one from a military angle in case of grave emergency; is it not?

Secretary McElroy. I think it is a rather difficult one, but I think it is the one that would be supported by public opinion in this country.

Mr. McCormack. Well, public opinion is not going to win wars. We are coming down to leadership.

Secretary McElroy. In any case——

Mr. McCormack. Public opinion is important, but other things win wars.

Secretary McElroy. I agree that this is a very difficult thing militarily, Mr. McCormack.

Mr. McCormack. Well, we are tied to that.

Secretary McElroy. That is our policy.

Mr. McCormack. That is described by the President, by the executive branch. That is correct; is it not?

Secretary McElroy. That is currently true. Whether that will always be true I think could be something else, Mr. McCormack.

Mr. McCormack. Well, I am glad to get that latter now because that is a little relaxation. Could you see conditions under which that would no apply?

Secretary McElroy. This would again be a matter of national policy which would take quite high review. I think I must return to where I began, which is that for the present and the indeterminate future our policy is not to attack with the big weapons first.

Mr. McCormack. What do you mean not to attack with big weapons first, would we attack with other weapons first?

Secretary McElroy. No, I think we would not attack first even with other weapons.

Mr. McCormack. So no matter how powerful our military might be we are strictly in a defensive posture.

Secretary McElroy. Yes, because we are not aggressors.

Mr. McCormack. I just want to have that established. Now our main reliance, of course, is SAC. That is correct, is it not?

Secretary McElroy. Yes, our principal deterrent is the Strategic Air Command. We have other very major elements.

Mr. McCormack. Well, that is true, but you have already said on a number of occasions—only in the U.S. News & World Report a few weeks ago—that our principal reliance at this time is on the heavy and medium bomber capacity of the Strategic Air Command—that is certainly No. 1.

Secretary McElroy. That is correct, that is true.

Mr. McCormack. Well, suppose they have a defense against our bombers, what then?

Secretary McElroy. Well, of course, if they have a defense against anything that we have then it makes our problem just that much tougher. But I think we have some right to judgments on whether or not they can have a defense against our bombers that will keep us out and I think that the belief of our military people is that they will not keep us out any more than we can keep all of their bombers out if they come at us.

Mr. McCormack. Well, of course it is not a question of keeping them all out, it is a question of the attrition rate.

Secretary McElroy. Yes, there would be some attrition.

Mr. McCormack. If the rate is too high there is the question of sustaining the attack?

Secretary McElroy. There would be a question of sustaining but I think in this kind of war you are likely to use most of what you have in your initial strike.

Mr. McCormack. We are going to strike after we are hit?

Secretary McElroy. Yes, but you are going to use most of what you have left.

Mr. McCormack. You have also stated that within a year or two you expect the Soviet Union to be considerably ahead of us in intercontinental ballistic missiles.

Secretary McElroy. I do not expect that they will. I consistently say that they can be. The intelligence that we have, of course, does not get inside the Russian mind to know what they are going to do. The only thing we can judge is what they could do with their facilities of scientists, facilities of materials, their facilities of production, manpower, and so on. Now then, there is one of the interesting points really that is under discussion in this general debate. We do assume in what we are preparing to do with our own forces that they will make use of their top scientists and their material facilities and their production facilities to make this quantity of weapons but we do not say they will produce these. We say they could produce these if they had the national decision to do so.

Mr. McCormack. Well, it is reasonable to assume they are going to do what they think they ought to do.

Secretary McElroy. Yes; but the interesting point in retrospect on that, Mr. McCormack, lies in the history of that they did on heavy bombers.

Mr. McElroy. I know. You refer to that in this article here. You refer to General Twining's views when he came back from Moscow. Is that what you have reference to?

Secretary McElroy. Yes. General Twining—and he can speak for himself at any point here if you would like him to—came back from Moscow feeling that the Russian capability to manufacture heavy bombers was such that we could really expect Russia to have a superiority of heavy bomber capabilities over the United States. This was very disturbing to the country. He had this capability but he did not produce it. Why, I do not know. Everybody has his own theory as to why he did not do so. In addition to a capability to do, you have to have a national decision to do. The only thing we can say in our intelligence is that he has the capability to do; whether he is going to make the national decision to do we do not know.

Mr. McCormack. Might it not be that they concentrated on missiles rather than bombers realizing that the perfecting of missiles would more or less outmode bombers?

Secretary McElroy. The thing that makes that doubtful is our observation of new bombers in the air over there, so they have not given up bomber aircraft. They have an advanced bomber, we believe, in test.

Mr. McCormack. I do not want to appear to be in a position of cross examining any of you gentlemen, because we are all Americans. We all want to do the best we can.

Secretary McElroy. Surely.

Mr. McCormack. We have our limitations up here. We can appropriate money, but we can't compel it to be spent. We have seen that in the Army and the Marine Corps in the last year.

By the way, do you think the reduction in our Army, in the light of the situation today, was wise?

Secretary McElroy. We think the size of the Army is adequate.

Mr. McCormack. That isn't answering my question.

Secretary McElroy. I will leave it there.

The Chairman. Mr. Fulton.

Mr. McCormack. No; I have just one or two more questions.

The Chairman. Excuse me.

Mr. McCormack. For the benefit of the people: What is your opinion as to the relationship of the Soviet Union and our own country in the development of the intercontinental ballistic missile? Are they ahead of us?

Secretary McElroy. My judgment is—and when I say "my judgment," let me say that this is a distillation of the views of the intelligence community and of our own scientists, so that I am not talking as an individual, I am simply reflecting a combined view—my judgment in that context is that developmentally we are very close to each other in the development stage of the ICBM.

Mr. Khrushchev announced, I would guess maybe a couple of months ago, maybe not quite that much, that their ICBM was in serial production. This was a term not commonly understood here. It was interpreted by some to mean mass production, and you all may have

read recently that a Russian scientist who was in this country explained—and this was reported in the New York Times—that "serial production" is not mass production but is production that is in between prototype production and mass production.

I can read it right here, if the committee would be interested.

This is in the New York Times of Friday, February 13, and this was a meeting of scientists.

The questioning shifted momentarily "as Mr. Lebedev explained the 'serial production' of the intercontinental ballistic missile. He said this was an intermediary stage"—I guess intermediate is what should be here—I hate to correct the New York Times. Maybe I better not do that. "He said this was an intermediate stage between the 'specimen' or 'prototype,' and mass production." "It means, he said," "the production of limited quantities."

Now, of course, the Atlas is in serial production in that sense. I believe that this committee has visited the production facilities of the Atlas, has it not? I know that you have been down at Cape Canaveral and at Huntsville.

In any case, if you have observed this, the Atlas missiles are moving through on what I would consider in this sense serial production; but whether we are in serial production or not doesn't make much difference to me.

I think in answer to your question, sir, that the evidence seems to me to be that there is very little difference in the development stage of their missile and ours from everything that we can judge.

Mr. McCormack. Would you express an opinion, either you or General Twining—I know when you express your opinion it is the collective judgment of many others—as to how long the SAC will be our main reliance so far as retaliatory action is concerned?

Secretary McElroy. Well, in answering this, I think we should make clear that the intercontinental ballistic missiles are being assigned for deployment to SAC, so I think your question has to do with SAC bombers.

Mr. McCormack. I am talking about the bombers now.

General Twining. Well, I think it will be several years, certainly until sufficient quantities of the ICBM's of proven dependability are not only in stockpile but on launchers. Then it will be a combination of the two. The bombers will still stay as the missiles come in. Even though the ICBM's may be perfect, we still want the capability from the manned bombers, for, I would say, 10 or 15 years, but not just the bomber. It will be the missile, too—a combination of both. But SAC will still be the unit, as the Secretary said, that is the deterrent force for the country. It will always maintain the deterrent, with a combination later on of both the missile and the airman.

Mr. McCormack. Is it fair to assume that there might be discoveries through tests and a satisfactory bomber might be used more effectively than now; whether there might be a capacity to project a weapon a longer distance than they can now toward the target?

General Twining. The Hound Dog is an example of that. I am thinking of that when I say the bomber will stay with us 10 or 15 years. The bomber can carry a great load of nuclear power and pinpoint targets, and you will need that capability.

Mr. McCormack. The greater the increase in the mileage from the target, the more effective the bomber will be in the future?

General TWINING. It can stand off a thousand miles from a target, keep out of a heavily defended area, and launch a missile from a bomber.

Mr. MCCORMACK. Is it reasonable to assume there is a capability of 500 miles?

General TWINING. Definitely. We are encouraged on that.

Mr. MCCORMACK. Mr. Secretary, you said a few weeks ago that the danger from the Russian conspiracy is about the same: "I think they intend to destroy us if they can, one way or another."

You remember you said that in the interview with United States News & World Report?

Secretary MCELROY. Yes.

Mr. MCCORMACK. That is still your opinion today?

Secretary MCELROY. It is my belief.

Mr. MCCORMACK. Have the events of the past week, the visit of the representative of an ally of ours, caused you to change your opinion?

Secretary MCELROY. If anything, it has reaffirmed my opinion.

Mr. MCCORMACK. Just one more field: Is there any consideration being given to the establishment of one agency in the field of outer space to take over military and civilian research and development?

Secretary MCELROY. There is nothing current in that direction. It is our belief in the Department of Defense that the agency that has been set up, and the Space Council which has been set up to give common direction to the overall program, can best do its work along with the military as carrying a portion of this responsibility.

We think that it would be a quite doubtful thing for the military use of space to be assigned outside of the military for development, with all that could mean—not necessarily would mean, but all that it could mean—of difference in point of view on the part of the military and of the other agency as to the importance militarily of certain use of outer space.

Mr. MCCORMACK. Well, you have used very guarded language, which I understand, I think.

In other words, you think it would be a great mistake if military research and development was to be transferred to an agency embracing both military research and development and civilian?

Secretary MCELROY. I think the present setup is a good setup and will be workable.

Mr. MCCORMACK. Well, there are many twilight zones on some of those questions I would judge?

Secretary MCELROY. Yes; there are; but I don't see why we can't work this out as reasonable men working together. In the aeronautical field, Mr. McCormack, when NACA was the agency, the Department of Defense really had no problem in working out the division of functions as between the two groups.

Mr. MCCORMACK. But the powers of the two are different now. You have more power in NASA than in NACA. They are more competitive.

Secretary MCELROY. They have somewhat more power, but I think the legislation was very well written to reserve to the military the military use of space.

Mr. MCCORMACK. Well, take the twilight zone, don't you think the doubt should be resolved in the world of today on the side of the military?

Secretary McElroy. I think I would prefer to say, Mr. McCormack, that the President, as the Chairman of the Space Council——

Mr. McCormack. I was chairman of the committee.

Secretary McElroy. I know you were, sir. I think it was a wise conclusion that any doubts that there are as to jurisdiction should be resolvable at the highest executive level through the Space Council, of course, which is chairmanned by the President.

Mr. McCormack. We put language in our bill that the Congress further declares that such activities shall be the responsibility of and directed by a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with development of weapons systems, military operations, or the defense of the United States, and, in brackets, making it stronger, including the research and development to make effective the defense of the United States, shall be the responsibility of and shall be directed by the Department of Defense, and that determination as to which such agency has responsibility for and direction of such activity shall be made by the President in conformity with section 201(e).

That is pretty strong language there, and we made it just as strong as we could. In other words, if there is a situation that develops in the world of today—tomorrow it might be different, but in the world of today we have to consider these things. What might be military today may not be in a peaceful world, we recognize that, but in case there is any attempt to transfer what is considered to be of vital importance to our country in the military field, are you prepared to fight for the retention by the military of those things you consider to be essential for our preservation?

Secretary McElroy. Without any hesitation. And I think on the other side that I am not likely to need to fight, because the man who is the head of NASA is a man who is, I think, a very reasonable man and a very good man. I think the point was excellent, and I don't anticipate any problem at all in working these out with Mr. Glennan. But if for some reason or other there is an honest difference between him and me, I would certainly be quite prepared to fight, yes.

The Chairman. Mr. Fulton.

Mr. Fulton. May I just ask one question in advance? I have been asked to ask this question.

There is an article in the morning's New York Times which attributes the loss of the satellite which was launched out on the Pacific coast to the lack of cooperation between agencies authorized to engage in space. The charge is made by Dr. J. Allen Hynek.

What would you say about that, Mr. Secretary?

Secretary McElroy. I asked that question of my associates in the Department, because I thought perhaps it might come up this morning, and I am assured that all observation or tracking of satellites that was believed to have any opportunity really of tracking or observing was notified about this, and if there was not notification of this particular station, it was not because of any conflict between space agencies. It was solely because the judgment of the people who were sending this notification around to the various observation or tracking stations in the world was that this particular satellite would not be observable by this particular station.

The CHAIRMAN. He needs 24 hours' notice. He says he could be of help if given the notice.

Secretary MCELROY. There may be a difference of opinion between this scientist and the people in charge of this program as to whether or not this station could have been helpful, but it had nothing to do with any overlapping or conflicting competition between space agencies.

Mr. FULTON. Tell me the time, so I won't go too far.

We are glad to have you here, Mr. Secretary and General Twining, and I think you are certainly contributing to the security and defense of this country and the free world, and we want to thank you on behalf of this committee and my own people for the good job you are doing.

When it comes to who shall attack first, isn't it provided under the Constitution that the Congress shall declare the war and gives the authority for making the attack?

Secretary MCELROY. Yes, this is in the Constitution.

Mr. FULTON. So the military, itself, doesn't make that decision, the Congress does, but if there is not time for retaliation and a posture to defend against an obvious attack, it is the President wh makes the authorization, is it not?

Secretary MCELROY. Yes. It would not be the military without civilian authority.

Mr. FULTON. So you and I both agree with Harry Truman when he took that posture in the Korean war, because it had to be done immediately?

Secretary MCELROY. Oh, yes.

Mr. FULTON. We shouldn't forget that Congress has the power to declare war, and we shouldn't be talking of attacking or authorizing an attack in this country without Congress authorizing it under the Constitution, isn't that right?

Secretary MCELROY. That would be my feeling.

Mr. FULTON. Thank you.

Then our defense——

Mr. MCCORMACK. Do you want to limit your answer to that completely now, as to the powers of the President?

Secretary MCELROY. I am not binding the President. I am binding myself. This is a matter which is written into the Constitution, and as it is written into the Constitution, I have no choice but to answer Mr. Fulton as I have.

Mr. FULTON. The next point is this:

In the defense of the United States and the free world, we base our defense system on a balanced defense structure. That means that we don't depend on any one weapon or group of weapons or any weaponry system, but we have a broad system across the board, isn't that right?

Secretary MCELROY. It is, and it consists of whatever combination of weapons system best serves our particular situation.

Mr. FULTON. Then when you referred to the Strategic Air Command, we already urged using some missiles to help them, and we are going to increase those missiles. For example, we have in production the Snark, an IRBM guided missile, which can go .94 of the speed of sound, mach 1, and that will be supplementing, even before we give up

the manned bombers, just as maybe the Hound Dog, and the Air Force would come in and help us, is that not right?

I will ask the general.

General TWINING. That is correct.

Mr. FULTON. So we are not going to have one particular time when manned bombers or the SAC is obsolete. We will gradually feed in and supplement the present force with backup missiles, IRBM's, and air-to-air and other types, like Sidewinders and things of that type, is that not right?

General TWINING. That is correct; keep the forces in balance. Diversification gives great strength in any military force. Of course, we want to get the best weapons for all of these forces, but it is not—it does not necessarily mean that we have to go out completely on one line of defensive force. We must have diversification.

Mr. FULTON. We have heard all of this talk about the Russians and the ICBM's, and they might be used in some indefinite date in the future, but we likewise must look at a threat as a continuing threat right at the present time, right straight through. The dependence, as you move through that period, may vary as to what weight you give various weapons, depending on geography, the totality of the threat, and whether it is a limited threat, isn't that right?

Secretary MCELROY. We think that that is very right, and we think the availability of the diversification of a delivery system puts you in a position to use anything which at a given time has a particular effectiveness against the background of the total defensive capability of the enemy.

Mr. FULTON. So that the particular phase we are in now—and I am a member of the House Foreign Affairs Committee—is a May 27 deadline that has been given to us on Berlin.

Now, are we able at the present time to adequately protect our firm position taken by the President and likewise by Mr. Macmillan—I understand on his visit to Russia—or are we not in such a position?

If we are not, what should we do? Should we mobilize in full or in part?

Secretary MCELROY. What we should do as we move along in what is the developing prevailing situation is something which has had very specific consideration by the Joint Chiefs of Staff along with the Department of State. This is something which we cannot discuss in detail, but we are prepared to meet various stages of this Berlin situation as it develops, and we are prepared to make good on the statement of the President that we will not yield one inch in our rights in Berlin.

Mr. FULTON. That is very reassuring that you say we will not yield an inch and we are able to reinforce it. I think that the American people will be glad to hear that.

Then it isn't quite correct to say, is it, that if the Russians get their ICBM in quantity, then we would have nothing against it, because actually we would have 250 bases abroad? They would have no such bases abroad. We would have our nuclear submarines. We would have the Polaris, the Juno, the Thor, the Jupiter, the Atlas, the Titan, the Snark, the Hounddog, and many others?

Secretary MCELROY. We don't have the Polaris yet.

Mr. FULTON. But if the Russians had 150 ICBM's, it wouldn't be correct to say we would then have nothing, because by then we would have a lot?

Secretary MCELROY. That is right.

Mr. FULTON. Then I think it ought to be cleared up, because I have never heard anything to the effect that the Russians have been able to shoot an ICBM and get a reentry—that is, a target reentry. All of this talk about the Russians having ICBM's in some kind of serial production is really meaningless until they can make it into something that can hit a target with reasonable accuracy.

Now, have you ever heard—I have not—of any Russian flight that has ever had a CEP, circle of probable error—or that they have released any statement that has told us they were able to have a degree of accuracy which would be a weaponry system on any ICBM, nor have they given us a date in the future for that?

Secretary MCELROY. There have been some quite broad claims of high accuracy, but not in any such specific terms as to justify any judgments on our part as to what validity there is for any claim of this kind.

It should be understood, too—and this is without thinking on our part that we should over-downgrade the Russian capability—it should be understood that there is in Russia a range for these firings of only about 3,500 miles. Everything that is needed for an attack on this country is in the range of 5,500 miles. The degree to which you can expect a test at 3,500 miles to be extendable on a 5,500-mile requirement is something about which you will find varying opinions among various scientists.

Mr. FULTON. And on the 3,500-mile range it goes off the eastern end of Asia, so that it would be a sea landing, and they have no equipment, no *Vityaz* over there, the hydrographic ship, to pick the stuff up.

Secretary MCELROY. Not that we know of.

Of course, there is no reason why they couldn't do so if they wanted to organize to do so.

Mr. FULTON. I want to bring to your attention this Russian ship, the *Vityaz*, that has bracketed our whole west coast and then moved out to the missile range, being able to pick out currents, sonar channels, temperatures, depths, so that they could find places where a submarine could lurk or get out of the sonar channels where we couldn't pick it up. I think that is something that is just a little bit more than doing a good job for the International Geophysical Year. Whereas we have been firm with a Russian trawler in the east, in the Atlantic, I think we should likewise have given notice that we want to have an American *Vityaz* that goes over into their missile range. We should just go up and down and pick up the range all the time, just as they have done, and let us take a few of their scientists out. I would suggest that we have a United States hydrographic ship that operates off the Sea of Okhotsk, maybe the Siberian Sea, and the East Siberian Sea. We can watch these missile ranges awhile, as they are doing, but only do it as an extension of the International Geophysical Year.

Now, we have other information. They do have a 1,100-mile intermediate missile range, do they not?

Secretary MCELROY. They have intermediate mileage missile ranges up to a thousand miles. Of course, they could have them up to 3,500 within their country.

Mr. FULTON. So that as far as we have been able to get from intelligence or from their statements, we have no evidence in this country of any Russian capability on an ICBM level that the ICBM can be used as a successful weapon with a target in mind?

I would like to pin that down at this time.

Secretary MCELROY. We are having to make assumptions about their accuracy, but for the purpose of our own calculations, we are assuming without knowing it that they have the same target accuracy that we would have with our firings. Whether that is true, I just don't know.

Mr. FULTON. We don't have any firm information at this time?

Secretary MCELROY. We think that is the conservative calculation from the standpoint of a country that thinks it might be attacked.

Mr. FULTON. Then let's go to the Nike-Zeus.

How long have I been?

The CHAIRMAN. Fifteen minutes.

I will say this: The Secretary has engagements tomorrow. Would you be able to come this afternoon, if we don't finish?

Secretary MCELROY. I have a luncheon at the White House that leaves the timing a little bit indeterminate, but I would certainly come back if you wanted me to come back this afternoon.

The CHAIRMAN. I know everybody on the committee is eager, the chairman is eager and so are the others, to ask many, many questions. I think the members are going to have to reduce the number of questions, and even then, Mr. Secretary, we may have to ask you, if you can work in some arrangement, to come this afternoon.

Secretary MCELROY. I will come this afternoon, if you like, sir.

The CHAIRMAN. All right, Mr. Fulton.

Mr. FULTON. The Army requested $730 million in the next 18 months, I think through Maj. Gen. Dwight E. Beach, for the manufacture of components for the Nike-Zeus, that is, to put it into production at the present time, which of course means a cutoff of research and development, is that not right?

Secretary MCELROY. You would have to freeze on certain specifications in order to go into production, and we are not ready for it in the opinion of our scientists.

Mr. FULTON. As a matter of fact, I have been a Navy lieutenant assigned for a time to the aircraft scheduling unit at Wright Air Force Base in Dayton, so I have had some experience in it. When you once freeze and put the model into production, if you are not up to a good percentage of accuracy and if you don't have the weapon in stage, you have put a ceiling on your research and development and must then go ahead on an inadequate weapon, is that not right?

Secretary MCELROY. That is a practical statement.

Mr. FULTON. Then the total Nike-Zeus system that would not seem to be called for, would, if put into production, would cost $7½ billion?

Secretary MCELROY. We think that would be minimal.

Mr. FULTON. And somebody would have to come up with the answer as to what taxes would have to be raised to raise $7½ billion during a 3-year period.

Secretary MCELROY. Yes, there is that question and also the question of whether you might not be better defended as a country if you

used a portion of that, or all of it, for the purpose of increasing your aggressive retaliatory potentiality, whether it might not be far more discouraging to the enemy for you to have a greater power to deliver destructive weapons on him than simply to defend against anything that he might throw at you.

Mr. FULTON. Then, because this is a nonpartisan approach to defense, I want to compliment Representative Mahon, of Texas, George Mahon, who is chairman of the Defense Subcommittee of the House Appropriations Committee, when he told the Associated Press: "I agree with the President that we should not provide funds at this time to go into production of the antimissile missile. I feel very strongly about this," says Representative Mahon.

Now, let me ask just a few more questions on background.

As a matter of fact, there are other competing weaponry systems for antimissiles that have been up for discussion. One of them was the Air Force Wizard. That was dropped, I believe, in January of 1958, was it not?

Secretary MCELROY. Yes.

Mr. FULTON. Then in addition, of course, the Navy has its air-to-surface Talos, which would be a sea-based missile, that might be a very fine deterrent, because they have done a perfectly wonderful job with the Sidewinder, so far. If they develop the Talos, maybe we might have a plane-carried missile rather than a land-based, fixed-point, antimissile missile like the Nike-Zeus might we not?

Secretary MCELROY. The Talos is a ground-to-air missile, and it is one which is regarded as having some possible interim capacity for anti-missile-missile use, but it would only be able to intercept at a *minimum altitude.*

Mr. FULTON. As a Navy man, might I also say it is a deck-to-air *missile too?*

Secretary MCELROY. Yes.

Mr. FULTON. But you see, that gives it mobility and maneuverability, which the Nike-Zeus based in Alaska, Greenland, and the Aleutian Islands would not have.

Let me get to something else.

The Nike-Zeus is to have an advanced radar system which probably would be pointed in one direction, and to take missiles as they came in.

Now, I think that is a great defect, because it isn't catching the missiles when they start. We already have had some research on picking up the ion-scattering of these missiles when they start off, when they are slow. Possibly with these new weather reconnaissance satellites, if we put a number of those up, we would be able to catch the missile as it started, rather than try to catch it when it started to reenter.

Now, may I ask you, on the angle of start from the pad, the angle of launch, that is very much narrower than the angle of reception which can be very broad, is that not right?

Secretary MCELROY. Well, this is a question which I think I could very well get over my head in answering. This becomes sufficiently technical that I would like to be excused, Mr. Fulton, from answering.

Mr. FULTON. Would the General answer?

General TWINING. I would hesitate to answer that one, Mr. Fulton. We can put it into the record, if you would like.

Mr. FULTON. Then if we only have Nike-Zeus installations, with advanced radar receptivity to pick up, up to 15,000 miles an hour, ICBM's in Greenland, Alaska, and the British Isles, obviously that kind of program would not protect the whole United States. It would just protect the particular area, coming from the northeast, where these missiles might likely be coming into our major industrial places and cities, isn't that right?

Secretary MCELROY. They have a very wide area of coverage. We are assuming, of course, that we are going to receive this attack during the few years ahead, if we are going to get it, from some place in Russia.

Mr. FULTON. Yes, but they are the current missile bases we know of, and we haven't taken into consideration the 443 submarines Russia now has, nor the submarines they might build that are nuclear submarines to offset us with the Polaris.

Secretary MCELROY. If we are to observe incoming missiles of the Polaris type that the Russians might at some point be capable of firing at us, these particular BMEWS stations would not observe those. We will have to have other defenses for that.

Mr. FULTON. So against the massive threat of submarine warfare, even at the 500-mile range, the Nike-Zeus is no good at all?

Secretary MCELROY. Well, it would have to be tied in with a different type of warning, that is correct, different type of observation and different type of warning.

Mr. FULTON. With the Russians having 443 submarines that can be modified for deck-type misiles of 500 to 1,000 or 1,100-mile range, IRBM, we would then be caught with maybe megaton bombs regardless of Nike-Zeus if we went ahead and put the whole program in and spent the $7.5 billion?

Secretary MCELROY. Well, that is true, sir.

Mr. FULTON. So Nike-Zeus is no solution overall to the problem of either IRBM's or ICBM's as far as the defense of this country or the free world is concerned, isn't that right?

Secretary MCELROY. It would do only a part of the job, and we don't know how much it would do because we haven't enough knowledge yet.

Mr. FULTON. That is fine.

So therefore you must look at other systems which might be taken to be more effective, such as the weather satellites, equitarial satellites, polar satellites that will scan and come up with missiles as they start?

Secretary MCELROY. Well, all of which, Mr. Fulton, tells us that because of the just incredible expense of these defensive systems even a country with the tremendous resources of this country may have to make a determination which is a quite basic one as to whether the thing for us to do is to put large amounts of money into passive defense or to put ourselves in so invincible a position to deliver destruction that we would not be attacked because of the fear of an attacking nation of his own destruction.

Mr. FULTON. The deterrent then makes for peace rather than looking ahead always for war, is that not right?

Secretary MCELROY. That is right. That is the objective of the deterrent.

Mr. FULTON. May I finish with another idea and take this just from a Navy lieutenant?

We are always talking about intercepting and knocking down the missiles. Why don't we talk about boosting them, shoving them on, the ICBM's, pushing them on around the world and letting them fall on Russia; just give them a boost?

Secretary McElroy. I think that is a better idea. What the scientists could do with that one I don't know, but I am certainly for that.

Mr. Fulton. Well, we might energize them with maybe some infared on their tails and put them out of course and give them another shove. If we take an ICBM and put it up six or seven thousand miles an hour, it orbits, doesn't it?

Secretary McElroy. Yes.

Mr. Fulton. So maybe the thing to do, instead of knocking them down, is to put them into orbit, isn't that right?

Secretary McElroy. I know that it is right if we could do it.

Mr. Fulton. Are we trying that?

General Twining. I don't know of any project on that yet.

Mr. Fulton. Why don't we try that?

The Chairman. We might send them all up to the moon.

General Twining. It is all interesting to think about.

The Chairman. Mr. Miller.

Mr. Miller. General, a lot of this has been a little fantastic to me. It goes a little beyond me, boosting these weapons. I just don't know how we are going to do it, so I am going to try to get back to earth.

You did, as I understand it, in answer to a question by Mr. Fulton, say that we must have a weapons system across the board.

I take it then that that means we are not going to put all our eggs in one basket. We want a complete weapons system to meet the threat of aggression?

Secretary McElroy. What we believe, Mr. Miller, is that our country, defensively, should take its own particular strengths into account and should build on those strengths. We think that that is a better way to build a defensive system than to look at what an opponent may be doing in building on his particular strengths and simply following him blindly. That is the real point of what we are saying about the administration's defense program.

Mr. Miller. In other words, we should initiate our own systems rather than to follow his?

Secretary McElroy. Blindly.

Mr. Miller. But in the things we feel are essential, we should have them across the board and have the best we can get?

Secretary McElroy. We should always have the best we can get. We should use any of them, whether he uses them or not; the fact that he uses them shouldn't keep us away from them.

Mr. Miller. That is what disturbs me, because, Mr. Secretary, you remember attending and addressing the banquet of the Women's Forum of National Security, on about January 29, at the Statler? You made a statement there that I jotted down, because it rather struck me. You said, and I quote:

"While we cannot be first in every detail, we must be first in overall elements of defense."

What do we mean we cannot be first in every detail? I am assuming that the details there are those that we elect to take. Must we have a second-best segment of either aggression or defense?

Secretary McElroy. Perhaps I can give you an example if you would like me to do so, Mr. Miller.

The Russian, in our opinion, has far more military requirement of submarine capability than this country has. He has this because the United States, in order to bring in the raw materials it requires, industrial raw materials, and in order to make good its commitments to its allies, and for many reasons, in order to maintain its military strength, which is an allied military strength, must use the high seas for delivering and receiving goods. Russia, on the other hand, is a land-mass country. It does not depend importantly on trade for its strength. It uses its satellites. Its uses China to the extent that need be. So that whereas we would not gain anything at all comparable if we built up the same kind of submarine force, because Russia is not dependent on sea trade, he on the other hand, finds plenty of military reason for building a very large submarine fleet. That is the kind of thing I mean, where we should have the very best submarines to the extent that we have submarines, and I think we have got much better submarines than he has, but we should not, because he builds 450 submarines, build 450 submarines.

Mr. Miller. I agree with you. I think we have much better submarines than he has, but we haven't got enough.

Do you agree with that?

Secretary McElroy. Whether we have enough is another question, but I would never build 450 of them, because he has 450, because we have a different requirement for submarines than he has.

Mr. Miller. I would defer to your judgment there and the judgment of the Chiefs of Staff.

On the other hand, we have quite a submarine defensive capability with surface ships that the Russian has not, is that true?

Secretary McElroy. A submarine defensive capability with surface ships, yes, we do.

Mr. Miller. And the Russians haven't got that?

Secretary McElroy. Well, he is building up his surface navy pretty well.

Mr. Miller. That is why I wonder where we begin to play second string. I am not concerned whether it is in this field, whether it is in the field of an anti-missile-missile, or whether it is in the field of SAC. I just want to know whether it is the philosophy of the Department of Defense that we can be second in any facet of defense or offense that is essential ot this country.

Secretary McElroy. Well, now, when you say "facet," if you are talking——

Mr. Miller. Well, any element or any department of defense, any section or department.

Secretary McElroy. Let me say this, Mr. Miller:

I don't know whether it answers your question. We must have an adequate capability to protect this country's security. That is a very broad kind of statement, and it may not be satisfactory to your line of questioning, but we must be in a position, for example, No. 1, to deter an attack on us with large weapons; in other words, the initiation of general war. In order to deter, we must be in a position to destroy an enemy that might initiate such an attack against us. That is the No. 1 requirement that is against our defense program.

The No. 2 requirement, and it is almost a concomitant of the first, is we must be in a position to apply whatever power is required against various local situations as they develop around the world. We must apply that power promptly in order to discourage the break-out of local conflict, and if they do break out, to contain them so that they don't expand and become big conflicts.

There we need things like our aircraft carriers. We need a mobile force of Marines and Army, and we need a requirement of airlift to support and a requirement of sealift to support. We need whatever is necessary in the way of escorting ships to protect this sealift.

Now, all of this seems to me to be a requirement that is put upon us to do to the extent required, and the extent required has got to take into consideration the opposition that you would find from a possible opponent.

Now, that is the way we approach our job, and I think that the confidence of your Department of Defense, and I would say of your Joint Chiefs of Staff, is that we are adequately set up to do these first and second major assignments.

Mr. MILLER. Mr. Secretary, the reason I raised that, and the reason I noted your remark, was that some years ago we were taught and told that there was no such thing as a second-class army or a second-class defense or a second-class air force, and I was wondering whether there was an eroding away now; that because it was going to cost dollars, we could have second class in the defense establishment. When I speak of the "defense establishment," I speak of it generically, the one that is going to carry on aggressive warfare as well as the one that is going to carry on defensive warfare.

Secretary MCELROY. I don't think that you can stand to have a second-class defense. I don't think you can stand that. This country can't stand it, and it doesn't have to.

Mr. MILLER. I won't argue with you as to the number of submarines we must have, as long as we have the first-class defense against submarines; whether it comes from the surface or beneath is immaterial. That also goes for the Air Force. I have just a couple more questions.

Is the ballistic missile early warning system going to replace SAGE and DEW line or does it supplement them, or what happens in that area?

Secretary MCELROY. It won't replace DEW line. DEW line will continue as the protection against manned bombers, because we are not assuming from the Russian buildup of an intercontinental ballistic missile capability, that they will simplify our defense by simply giving up bombers. That we don't quite believe is going to happen. But we think we will have to maintain a detection and defense against manned bombers until such time as this assumption that I am making to you proves false. So what we have to have is a detection system which is a superior detection system in terms of range for the ballistic missile warning in order for us to have sufficient time warning to get whatever retaliatory force we want to put in the air, get it off the ground and on its way, and if we have our defensive system against ballistic missiles for that time, to get it working in relationship to the incoming missile warheads. So we have to maintain both of those.

Mr. MILLER. So all of these would be——

Secretary MCELROY. We have to maintain both of them for an indeterminate period.

Mr. MILLER. Now, the next and last question I would like to ask, Mr. Chairman, I would rather direct toward General Twining, if permissible.

General, will the Air Force be as reluctant to abandon manned aircraft, to which it is apparently wedded, as the Army was to getting rid of the cavalry? Are we going to have that same old drag? The boys didn't want to give up their spurs, so we kept the horses so we could have the spurs and riding crops. I might say I was in a mounted service in World War I, and I know how nice it was to have spurs that jingled-jingled on the dance floor, and you could whip your riding crop against your britches. I just want to know what is the position of the Air Force about the manned bomber.

General TWINING. I think the point you bring out about the cavalry and the reluctance to give up the service will still exist in the Air Force. But I think that costs alone, when it comes to that point, will prohibit both, and I am sure that the Air Force realizes what these deadly weapons are. When the missile can really take over the job, has to be proven. We must not give up our heavy bomber force. We know what it can do. It has proved its case. It is getting better all the time, and we must not give that up until we are sure this missile can do the job. But I still feel there will be some reluctance on the part of the pilot and the Air Force to get rid of the bomber, sure, but that will have to be pushed from the top.

Again, I will say these weapons are going to cost so much that the dollars will have to be very well spent, and the Air Force will put it in the right place.

The Secretary of Defense is helping.

Mr. MILLER. They will be willing to return it. I may say in closing that I only wish that there had been as much reluctance to place confidence in other fields as in the case of the Army, that I feel we are completely cutting the heart of it right now. That is all I have got to say.

The CHAIRMAN. Mr. McDonough.

Mr. MCDONOUGH. Mr. Secretary, I have been informed that the shot at Vandenberg Field, Discoverer I, was a highly successful failure, as stated in the press, meaning that we sought to obtain some knowledge as to the propellant value of the rocket, but we didn't apparently put the satellite in orbit.

What did we learn from that shot that we didn't know before?

Secretary MCELROY. I can't tell you what we learned because that had not yet been processed when I left the office this morning, but the intent of the entire Discoverer program, of course, is to find ways to develop the use of a satellite for a variety of packages that it may carry in the future.

Principally, these are inanimate packages. They are packages of communications equipment. They are packages of weather-observing equipment. They are packages of surveillance equipment. But they also would be expected to generate information which would be turned over as all of this information does go back and forth to the space agency, which has the responsibility for the developing of a man-in-

space program. But I can't answer you specifically about just what we learned on this one, and we didn't even know this morning definitely whether it is orbiting.

There was an indication that it was, but again it was one of those things that didn't have quite the positiveness about it I would like to report to you.

Mr. McDonough. Did we use any new propellants or any new type of rocket propulsion in this shot that we didn't do before?

Secretary McElroy. Again, this is something sufficiently technical that I can't specifically answer you on it. I can only say that this was not primarily a propellant test. This was primarily a test of the package that is in the satellite, itself.

Mr. McDonough. In your discussion with Mr. Fulton a moment ago—the detection we have on rockets is mostly on the eastern coast of the United States.

What do we have to protect and detect the west coast in the event of a shot in that are?

Secretary McElroy. Well, you would have a similar facility in Alaska.

Mr. McDonough. Well, what about way down south, Central and South America?

Secretary McElroy. We don't think they will come from there. The distances are infinitely increased. It must add three or four thousand miles, unless you come over the pole.

Mr. McDonough. And in coming over the pole, the Alaskan detection system is the only one we have?

Secretary McElroy. But you should have in mind, and this much we do know, that a combination of Alaska and Greenland overlap each other. The scope of this thing is so tremendous, these are colossal things, and each one of them costs, as I am sure you have been told, some hundreds of millions of dollars, to give you some idea of what the size and scope of these are.

But this does give you the coverage that is required. That is the only thing that you can say is economical about these—that you don't need to have a whole fistful of them up there.

Mr. McDonough. Do we have cooperation and coordination with Canada on such a detection system?

Secretary McElroy. Yes. It happens in this instances we do not have a location of these on Canadian soil, Greenland, of course, being Denmark, and Alaska being our own, but a good many of the lines coming down have to use lines which come across Canada, and our entire continental defense system, as you know, is tied right in with Canada in the North American Continent.

Mr. McDonough. That is all.

The Chairman. Mr. Teague.

Mr. Teague. You have stated as to the Nike-Zeus program that you are not proceeding with Nike-Zeus based strictly on a scientific basis, is that correct?

Secretary McElroy. I would rather say it in positive terms.

We are proceeding on the basis of the best scientific techniques we have. We are proceeding in a research and development way.

Mr. Teague. Is it not true that a responsible scientific study group did recommend to proceed in production?

Secretary McElroy. There has been no scientific—well, let me back up a little bit. I think that there was a scientific advisory group that did recommend at one point that we move ahead with this program in a manufacturing way as well as research and development. I think there was one at that point.

Mr. Teague. I think there was too, Mr. Secretary. And I am concerned that maybe one or two persons come along after a recommendation has been made like that and would cause you to decide not to proceed when maybe you should proceed.

Secretary McElroy. That is always a question. In the field of science as you know there are people who have different judgments from looking at the same factual material. The advisers that guided me were not only the people in the Department of Defense itself on whom I placed the heaviest reliance, including Dr. York, but also as I say, scientific advisers who are available to the top administrative levels of the entire Government. A man has to make a decision as to which group to follow and I felt that the decision I made was the correct one. I do not know but what you might feel different. I do not know.

Mr. Teague. Mr. Secretary, I do not envy you the decisions you have to make as far as our national defense is concerned and I hope that this committee may help you to always make the correct decision, but there is no question but that a good offense is always a good defense. I would hope that we do not put all our eggs in one basket.

Now, Mr. Secretary, you have intimated a number of times this morning that you do not have sufficient money for offensive missiles. You have said that if there was more money to put into this program then probably it should go into offensive missiles. Is it true that you do not have the money you would like to have to put into your offensive missile program?

Secretary McElroy. No, I think that that might have been inferred from what I said, but I was not meaning to say that. What I was saying was that if you had a requirement of some $7½ billion to $10 billion as the price tag for a defensive system like that of Nike-Zeus, it would be essential that in looking at that you would consider what other things you might be able to buy for that same money. Because even a very rich country like this does not have indefinitely extendable resources. I do not mean just money. Money may be the big translator of it all but the big question is the use of your scientific manpower. You just plain run out of it after a while. In this country we are putting 50 percent of the scientific manpower of the country against military programs now as you probably know. We believe that the budget that is recommended by the President is adequate for the programs of national security as required at this time, so we are not asking for additional money at this time. We are saying, however, that we reserve the right to look at the development of the various major programs that we have under development and as any of those seem to have reached a point where they justify further funding, we reserve the right to come back to the Congress and ask for additional funds, for supplemental funds. We did that last year and I honestly believe that it is the proper way for the Defense Department to be run.

The CHAIRMAN. Mr. Secretary, I want to interrupt at this point. The warning bell has rung and you stated, I think, you had an appointment at the White House. We do not want to make you late for it, of course. What is your pleasure?

Secretary MCELROY. Well, I can stay here this morning if you want me to until 20 minutes of 1 or something like that.

The CHAIRMAN. Suppose we run until 12:30, would that be all right?

Secretary MCELROY. That would be fine.

Mr. TEAGUE. I have one more question. You do not need to comment on it if you do not want to. But from every television program, radio program, magazine or newspaper article, you can find contradictions as to the missile program. How good is your intelligence about the Russian missiles? You can comment or not as you wish.

Secretary MCELROY. I will comment in the general terms that I can comment. We think that the intelligence is good. Any time that you do not have hard intelligence—which means that you have seen it or heard it—you have an area of some uncertainty. We would like to have far better intelligence than we have, but after very careful appraisal of the validity of our intelligence—and this is the intelligence community view, the group getting together and reaching a common judgment about what the various strengths of our enemy are—our belief is that we cannot be very far away in these judgments from what the facts are.

Do you want to say any more about that?

General TWINING. No, I think that the military intelligence that we present is the best intelligence there is available and if anybody disagrees with it, that is their privilege, but they should not publish it in the newspaper. Let us stick to one intelligence. Of course you will have confusion when people do not believe. We believe in this intelligence, and we base our planning on it. If it is not right, I do not think it is correct for somebody else to take some other intelligence that is contrary to the intelligence of the United States that is being used by the Nation. Let us have one intelligence system. Sure it is not perfect. As the Secretary said, we are doing the best we can. No intelligence system is perfect and we are getting better at it, but let us use the agreed intelligence estimate. If we would stick to that we would not have a lot of this confusion.

The CHAIRMAN. Mr. Chenoweth.

Mr. CHENOWETH. Mr. Secretary, I want to commend you on your very frank and straightforward answers to all of these questions this morning. We are aware of the tremendous responsibilities and the heavy load you are carrying. I personally think you are doing a grand job and I think you have the confidence of the American people in what you are doing. That goes not only for you but all of the members of the Joint Chiefs.

Now I do not want to go too far afield, but I would be anxious to inquire about your concern as to the present military missile program. Should we appropriate more money for it or is there anything we should be doing that we are not doing as far as the military missile program is concerned?

Secretary McElroy. I think our program both in military missiles and satellites is an adequate program and a program of forward motion. We are in a field here of very rapid evolution. Any time you start out on a new type of weaponry you know that the first one you put out is going to be obsolete almost the minute you make it. We think we will be able to use the Atlas for some time but we all know that there are considerable deficiencies there. What we are trying to do is make some commonsense out of the maintenance of an adequate deterrent, using a combination of ICBM's aircraft, aircraft launched from aircraft carriers, aircraft of the fighter-bomber type, all of these combinations, and then move as rapidly as we can in the development of an ICBM like the Minuteman, which then has overcome many of the deficiencies of the first generation ICBM and can be relied on, I hope, for some considerable period of time to give us this ICBM deterrent force.

Mr. Chenoweth. Well, I was interested in what you said, Mr. Secretary, about the fact that all space explorations—all of the scientific studies and research being done in the space exploration program do not have military value at present. You are concerned with the military value and there is a certain field there beyond what the military is interested in right now.

Secretary McElroy. That is right, sir, although it also is true that because of the very very small knowledge of outer space that we now have that almost everything that is done of a nonmilitary nature in learning about the environmental aspects of outer space can be usable in the designing of the various kinds of devices which we want to use in outer space for military purposes.

Mr. Chenoweth. Well, as Secretary of Defense, you are charged with the defense of this country because you are concerned immediately with what will have practical application right now, not 10 or 15 years from now.

Secretary McElroy. That is right.

Mr. Chenoweth. We are concerned with the defense of this country at this moment.

Secretary McElroy. That is right, and one of the major things that we need from outer space is an improvement in communications, strictly military. I do not mean that it cannot be used for other than military, but we need it for military, we need it for surveillance, and we should go after it for that purpose.

Mr. Chenoweth. Do you feel we are spending an adequate amount of money as to missiles, intercontinental ballistic missiles?

Secretary McElroy. I do, sir. All of the three programs in intercontinental ballistic missiles are on this top national priority basis, and as such are constantly watched by an assistant specially assigned to this expediting purpose. That is the degree of importance I attach to it.

Mr. Chenoweth. That is why you appointed Dr. York?

Secretary McElroy. That happens to be Mr. Holaday. Dr. York has the general research and engineering responsibility in every part of the Defense Department.

Mr. Chenoweth. You mentioned you are retaining Mr. Holaday.

Secretary McElroy. Really as a true expediter of the entire missile program beyond the research and development field.

Mr. Chenoweth. What is the relationship between Mr. Holaday and Dr. York?

Secretary McElroy. Dr. York has the responsibility for the research and development aspects and is taking these over from Mr. Holaday. Those we are passing over to Dr. York so that Mr. Holaday from here on will concern himself primarily with keeping me informed of what may be things that I can do beyond the research and development phase.

Mr. Chenoweth. An expediter.

Secretary McElroy. Yes.

Mr. Chenoweth. I think that is all, Mr. Secretary. Thank you.

The Chairman. Mr. Secretary, I would not want your position to be misunderstood now, in stating that your prime interest is in military development of space. I can see that you and the Defense Department would be interested in the development of a space reconnaissance ship, for instance, would you not?

Secretary McElroy. We think of reconnaissance as definitely military.

The Chairman. Rather than peacetime use?

Secretary McElroy. I do not see much need for a peacetime use of reconnaissance. Maybe there is some but I have some difficulty in understanding what they might be, but a military use of a reconnaissance satellite is quite obvious.

The Chairman. What about a weather satellite?

Secretary McElroy. A weather satellite could have both military and civilian use and I think you could say for forecasting weather that any knowledge of cloud cover and that kind of thing around the world would help the meteorologist.

The Chairman. The Sentry program?

Secretary McElroy. It would also have some military importance, for obvious reasons.

The Chairman. The Sentry program would have a military importance?

Secretary McElroy. Yes, sir.

The Chairman. Most of the programs that you speak of have directly or indirectly military importance.

Secretary McElroy. At this stage when there is so little knowledge, as I said, Mr. Brooks, if you did not have the Civilian Space Agency you would probably have to do almost everything it is doing in order to understand the environmental aspects of your strictly military applications——

The Chairman. I would not want the country to feel that some of this is a luxury program. Rather it really is a survival program in my book.

Secretary McElroy. We do not consider it a luxury program.

The Chairman. Mr. Anfuso.

Mr. Anfuso. Mr. Secretary, I join with my colleague, Mr. Chenoweth, in saying that you have made a very frank statement before this committee and I think you are doing the best possible job any human being could do under the circumstances. I think this is a time when we all could stand a boost instead of a kick in the pants.

Secretary McElroy. I am much obliged.

Mr. Anfuso. Now, Mr. Secretary, the Berlin situation could very well involve us in a world conflict. That is a possibility, is it not?

Secretary McElroy. Every time you resist aggression you have to make up your mind you are willing to take it as a possibility.

Mr. ANFUSO. And, if that happened right now or in May or some other time this year, we would be in a better defensive and offensive posture than the Russians, is that not correct?

Secretary MCELROY. We think that we have definite superiority over the Russians offensively at this time.

Mr. ANFUSO. And we will have it all throughout this year. There is no question about that.

Secretary MCELROY. We have no doubt about it and I am sure General Twining, if you asked him the same question, would respond the same way if you would like him to.

General TWINING. Yes; I would agree with what the Secretary has said, Mr. Anfuso.

Mr. ANFUSO. So that we are not in such a tragically unprepared situation as was stated in the Senate last week?

Secretary MCELROY. We do not think so.

Mr. ANFUSO. You mentioned something about the offensive nature of our defense. I am inclined to agree with you for this reason. I believe that the Russians are taking the United States on a well-known runaround. I think that they want to show to all peoples that they can be first in all things and therefore they have started many things. As General Twining pointed out, he could not understand why they did not go on with certain things. I think by so doing they intend to keep on embarrassing us and promoting good propaganda throughout the world and getting us to follow them in many things on a large scale which may bankrupt us and finally reduce the United States to a second-rate power.

In other words, what I am trying to say is this: She is trying to be first to embarrass the United States and not necessarily to prepare for war. She thinks that she can win in the long run without the firing of a single shot or the declaration of a war. Would you agree with my thinking along those lines?

Secretary MCELROY. Yes; I do not think Russia cares how she defeats this country. I think she intends to stick right with it until she defeats us one way or another; and, as you have indicated in what you have already said, there are more ways to defeat the United States in the world than simply militarily, and a military way is a very expensive way for the aggressor.

Mr. ANFUSO. Mr. Secretary, you are a member, naturally, of the President's Security Council and no doubt this Berlin situation has come up before you and other members of the Security Council, is that correct?

Secretary MCELROY. Yes, sir.

Mr. ANFUSO. I do not know whether this is classified or not, but I would like to throw out a thought here. It might be to the advantage of the United States in the event that Russia turns over her authority to East Germany, and I think that is a foregone conclusion—I am convinced that she is going to do that. As I said, in preparation for such an event, I think it might be to the advantage of the United States if we turned over the authority over Berlin—that is the western part—to West Germany, with certain specific guaranties that we will stand 100 percent behind West Germany in whatever consequences resulted from that action. What I had in mind was specifically this: If then a situation did arise, it would be different from stopping an

American convoy or a British convoy or a French convoy. It would be Germans stopping a German convoy and then shooting might or might not take place. The matter might be referred to the United States or many other things could happen, but nevertheless it would be a situation which I think would enhance the prestige of West Germany and place us in a better light as far as world propaganda is concerned and also forestall the possibility of an all-out war.

I think the danger is greater when an American, British, or a French convoy tries to get through than it would be if the matter were left in the situation I described.

Do you care to coment on that, sir?

Secretary McElroy. I would like not to comment specifically on that, Mr. Anfuso, I think for obvious reasons. I would only caution this: We must be extremely careful that whatever of that sort may be considered must be something which could not be construed by the Russians as indicating any reduction in firmness on the part of the United States. I am sure you would agree with that.

Mr. Anfuso. I agree with that and I think I have laid emphasis on the fact that if we did make a decision like that we would state that we would back West Germany to the hilt and not budge 1 inch. It is only a question of maneuvering. That is my only point, the question of maneuvering, which would have a greater appeal to the undecided peoples of the world, which would raise the prestige of Western Germany, which would raise the prestige of the United States. There is not any question in my mind that when the Russians turn over their authority to the East Germans they are going to make East Germany bigger at least in the eyes of other peoples. We must do something to make West Germany feel that she will have even greater prestige, that she can deal with the Germans. It is my frank opinion, too, that Germans dealing with Germans may bring about a unification. There is one thing that I think the Russians do not want and that is the unification of Germany. She does not want it because she is still smarting over the defeat which a united Germany gave to her. Somehow in the back of my head I think that negotiations between Germans might eventually bring about the unification of Germany. Do you care to comment on that?

Secretary McElroy. I think I would remind you, Mr. Anfuso, of the very great reluctance, in fact the refusal of the present Government of West Germany to consider any direct negotiations so that I think whatever the practical aspects of what you are suggesting, I do not think it is a feasible thing at this time and I think this is something that is very firmly held as a point of view by the German Government.

Mr. Anfuso. Thank you. I have no further questions, Mr. Chairman.

The Chairman. Mr. Osmers.

Mr. Osmers. Mr. Chairman, I just want to make one thing absolutely clear before I direct a question at the Secretary. It is a fact, Mr. Secretary, that the Department of Defense exerts no direct control over NASA. That is correct, is it not—I am referring to the National Aeronautics and Space Administration?

Secretary McElroy. That is correct. The control of NASA is the control of the Space Council which is chairmaned by the President.

Mr. Osmers. In a situation—if this is within the scope of your knowledge—in a situation where national security might be involved,

who would have the authority to classify the information coming from NASA?

Secretary McElroy. May I file this for the record, Mr. Osmers, because I really do not know specifically.

(The requested information is as follows:)

The National Aeronautics and Space Administration, when it conducts programs of a direct national security nature and in direct support of DOD programs of a classified nature, may be requested by the Department of Defense to insure such classification and has authority and facilities to do so. In the event that programs of such sensitivity as to merit special handling are undertaken, there is ample provision that administration therefor, as well as actual reesarch, development, or procurement can be undertaken entirely within DOD channels. Accordingly, the question of authority to classify information coming from NASA would appear to be adequate insofar as DOD programs are concerned. Should questions of the propriety of declassification of certain programs not directly related to the Department of Defense occur, they can, as indicated by the Secretary of Defense, be accommodated through reference by any appropriate member to the National Aeronautics and Space Council for decision within that body.

Roy W. Johnson, *Director.*

Mr. Osmers. Mr. Chairman, in order that the purpose of my question may not be obscure; I read in the morning newspaper on page 1 something I was quite upset about until I came upon other information later—certain dates of rockets to Venus, the weights, the purposes, including some April 15 dates, August dates, and so on.

The Chairman. That——

Mr. Osmers. Mr. Chairman, if I may finish and defend you. When I came to the committee, very much exercised about the publication of these things which could do the Nation much harm should these things not happen, I find in Aviation Week of February 23, that there is a complete article containing all of the dates and the information which the chairman then was free to use, it having been published.

The Chairman. Furthermore I read it 2 or 3 days before in a daily newspaper and thirdly I cleared it with NASA before those figures were used yesterday. Yesterday morning we had a representative of NASA present who cleared every one of those dates.

Mr. Osmers. It would seem to me, Mr. Chairman, and I know how very security minded you are because of your background——

The Chairman. I want to correct myself, if the gentleman will yield. It was a representative from ARPA rather than NASA yesterday morning.

Mr. Osmers. Knowing, Mr. Chairman, of your extensive background in defense matters and knowing that you would not under any circumstances in the slightest degree give out information that might be helpful, it would seem to me that it would be a proper area for the Science and Astronautics Committee to look into—the wisdom of having the National Aeronautics and Space Administration make these premature announcements of things that may happen. Now I want to ask Mr. McElroy a question on another subject.

In view of the total experience which you have had, sir, as Secretary of Defense, would you care to make general comments to this committee in the sphere of the committee's operations, about the scientific education situation in this country, about our basic research situation, or general research and development picture and the educational facilities that we have to back it. Would you consider them

adequate, becoming adequate, inadequate; how would you describe them, sir?

Secretary McElroy. I will to some extent be parroting my highly respected associate Dr. Killian in some of what I say but I am very happy to take my cue on some of these things from Dr. Killian. In a recent talk he deplored what he considered the inadequacy of the attention being paid by this country to the development of knowledge beyond the present frontiers of scientific knowledge which is the kind of knowledge which comes from basic research. In some way or other this country has never made quite the contribution in the basic research field that it has done in such a magnificent way in applied research. I do not mean that there have not been major contributions, particularly in the field of medical science, and others as well. But nevertheless this does seem to be true and we have found such important help that we have received from Great Britain and Germany, in some fields which have been very important militarily. I refer to advances in basic scientific knowledge. I think it is important for this country to look at whether it should not enhance the proportion of its scientific capability that it is putting against the advancement of human knowledge in these areas, so that there will be something further along on which to build in the applied line.

Now from the standpoint of education, one of the more disturbing facts that has come out of analysis of the interests, the academic interests of the great family of students in colleges over the country, this past year reflected in the enrollments of this past fall, is that after a couple of years of pickup in enrollment in science and engineering there was a considerable dropoff. I think that it is a very unfortunate and regrettable thing. It can only be corrected, in my opinion, by a systematic program of improved teaching of science and mathematics in secondary schools with a guidance program for the better students, the capable students in that type of knowledge, so that while they are in these secondary school years the preparation will go on which is a required preparation for the colleges to build on in the future. If those youngsters go to college and have not taken the needed amounts of mathematics and science, the college has nothing to build on and it cannot go back and pick this up. It has to be done, in my opinion, at the level of the secondary school education. I have spent a little time on this in the past and I know that Dr. Conant, who has been studying the secondary schools of this country, has been doing a great deal of the same and with the same general kinds of conclusion. I do not know whether this quite answers the question.

Mr. Osmers. It does answer my question and it confirms an opinion which I have had—which I have never expressed quite so dramatically as the president of our National Science Teachers Association—that about 50 percent of our secondary school scientific teaching in circa 1910. But it seems to me this is a field in which this committee must interest itself if we are to maintain pace with other nations in the world. I think sometimes we give too much attention to how much money is being spent this year to build missiles rather than how much are we doing to maintain an even pace or to get ahead of the rest of the world in scientific knowledge, which is the basis upon which all missiles and everything else must be built.

Secretary McElroy. I think in the long pull, Mr. Osmers, the competition between our free world and the regimented world of our op-

ponents is far more likely to be won on the basis of the relative abilities of the two forms of society to utilize the intellectual capacities of their peoples for the development not just of military science but of the kind of science which also is at the root of any advancement of overall standard of living.

Mr. OSMERS. I think, Mr. Chairman, that statement goes right to the heart of the difficulty.

The CHAIRMAN. Mr. Mitchell.

Mr. MITCHELL. Thank you, Mr. Chairman. Mr. Secretary, my questions will be related to the Nike-Zeus. I would like to preface my remarks by saying that I have no preconceived idea as to whether or not Nike-Zeus should be put into production at this time or not, but there is confusion in my mind and I feel there is confusion in the minds of other members of the committee and of the public in general. Of course, I know, as you do, that the Army feels very strongly that at this time it should be put into production. So I think that the Army should have their day in court and my questions will be along the line: Have they been given an opportunity to present their case and has it been fairly reviewed?

Now, Mr. Secretary, did you appoint this group of scientists from the DOD to make a study as to the feasibility of production—did you order the study?

Secretary MCELROY. I ordered a review of studies that had already been made.

Mr. MITCHELL. Now that review was presented to you sometime this fall, I believe in November, is that not correct?

Secretary MCELROY. It was in the fall as we were approaching certain budgetary decisions.

Mr. MITCHELL. Was that the time that you were making budgetary decisions?

Secretary MCELROY. That is right, because it was quite obvious that an up-to-the minute analysis of what the situation was was necessary for a sound budget decision.

Mr. MITCHELL. Now these scientists were part of your team, they were Department of Defense scientists in the rocket and missile field, is that not correct?

Secretary MCELROY. They are not limited to the rocket and missile field.

Mr. MITCHELL. I did not mean to restrict it to that. But they are DOD personnel?

Secretary MCELROY. Some of them are but some of them are outsiders.

Mr. MITCHELL. Those that were assigned to make this review, Mr. Secretary, were they outsiders or were they Department of Defense?

Secretary MCELROY. There were some of each.

Mr. MITCHELL. Would you give us the names of those?

Secretary MCELROY. No; I do not think I will because I think this is the kind of information which is sufficiently restricted, because it is internal working within the Department, that I think I would hesitate to give these.

Mr. MITCHELL. Mr. Secretary, how many men made this review for you?

Secretary McElroy. Well, I cannot tell you that because the people that report to me report to me for a group and exactly how many they had in their group I do not think I could tell you. But I have had at least two groups, one in the Department of Defense and one as I have indicated here indirectly of a higher administrative level in government.

Mr. Mitchell. I am referring specifically to the Department of Defense group, not the others. The recommendation you received this fall was a favorable recommendation for production for Nike-Zeus, is that correct?

Secretary McElroy. There was one group that did give us such a recommendation, that is correct.

Mr. Mitchell. Well, that was a Department of Defense group, was it not?

Secretary McElroy. Yes.

Mr. Mitchell. Now you referred to another report given by those outside the Department, is that correct?

Secretary McElroy. I also have a report from some inside the Department who were my scientific advisers, official scientific advisers.

Mr. Mitchell. You are referring to Dr. York?

Secretary McElroy. Yes, Dr. York and his group.

Mr. Mitchell. Was he a part of the team that was ordered to make this review?

Secretary McElroy. Yes.

Mr. Mitchell. Of course that team you said made a favorable recommendation so I gather from that then, Mr. Secretary, that you overrode your own group of scientists and followed the recommendations of those outside the Department in failing to put Nike-Zeus into production.

Secretary McElroy. Well, you already heard in testimony before this committee what Dr. York thinks about this program. He is fully in support of the decision previously taken, very vigorously so.

Mr. Mitchell. I am aware of that, and I remember that clearly from his testimony. But I do not think that answers my question. You followed the recommendations of those outside the Department rather than your own——

Secretary McElroy. Dr. York was in the Department.

Mr. Mitchell. But we are talking about two conflicting recommendations, one made within the Department that it be put into production and one made from without the Department of Defense that it not be put into production.

Secretary McElroy. You are saying that there was only one within the Department. I am saying there were more than one.

Mr. Mitchell. When were they made?

Secretary McElroy. At the same time.

Mr. Mitchell. How many reports were made within the Department at the same time?

Secretary McElroy. As I say, the report that you are referring to was a formal report. The other was a review of that report by the people that are my scientific advisers.

Mr. Mitchell. Why would you order several different reviews of the same question at one time? I fail to get the point of that, Mr. Secretary.

Secretary McElroy. Well, the group that you are talking about is a group that is a continuing group in the field of missile science and they are advisory. But I also have a continuously employed scientist and he has what advisers he wants to pull to himself, to consider these matters and to advise me as to whether I should adopt that or whether I should not. In addition to that I have outside scientists as I say who are of top level on whom I draw for a judgment on a matter which is of this degree of importance. You see the kind of thing that we are talking about here is not a question of whether you spend $300 million or whether you spend $700 million. This is a question of whether you spend $7½ to $10 billion. You are making that decision when you make the decision about going into production and that is a very big decision and we are not ready for it.

The Chairman. Will the gentleman yield at that point?

Mr. Mitchell. I would be glad to, Mr. Chairman.

The Chairman. Can you not, Mr. Secretary, make a reviewable decision? Can you not, for instance, make a decision that you should lay the groundwork and preparation for going into production on that program to reduce the time lag when the missile is available? Can you not do that without any enormous expenditures subject to a review later on?

Secretary McElroy. Yes, but that is not what this gentleman is inquiring about. What is being asked by Mr. Mitchell is whether or not we were right in deciding to go the $300 million route instead of the $725 million route—if that was the figure—and the $725 million route was to go into production. And when you go into production you go into production. You do not go halfway into production. And the route of production is $7½ to $10 billion, in my opinion, minimum.

Mr. Fulton. But when the Joint Chiefs decided you were right you had some pretty good backing outside the Department, did you not?

Secretary McElroy. That is right.

Mr. Mitchell. This $7 to $10 billion was stretched over a period of years. It would only be an annual figure of $1 billion a year after production was begun, is that not right, Mr. Secretary?

Secretary McElroy. It would be a great deal more than that. If you spend a billion dollars a year you would have it ready in 10 years. I do not think anybody would be willing to wait 10 years to get it if it is any good.

Mr. Mitchell. As a matter of fact, the Army said they could have this ready and have a certain number available ready for shooting in 1963, is that not correct?

Secretary McElroy. My scientific advisers tell me you probably could do this if you were willing to freeze on what you have to do as to your components and if you did that you would have what they regard as an unworkable operation.

Mr. Mitchell. Of course there was a difference of opinion on that as well.

Secretary McElroy. Yes, sir. If the Army recommends one thing, I am sure they do it because they believe it was right.

Mr. Mitchell. In answer to Mr. Fulton's question, you said this program would be frozen as far as R. & D. work is concerned. I

don't exactly understand that, Mr. Secretary. I understand that you would have to freeze certain parts if you are going to produce, but you could continue with your R. & D., and if certain modifications were needed while on the assembly line, that modification work could be done.

Secretary McElroy. That is exactly the kind of thing we are talking about. I don't know whether you ever manufactured anything, but you probably have built a house, and if you made 10 or 12 changes in the house in the course of building it, you have some idea of the kind of thing we are talking about here. There are hundreds of thousands of parts to the kind of thing we are talking about, and this is an incredibly complex thing. In the opinion of the scientists, we should not go into production at this time. That is the decision that we took. It is a decision that was counter to what the Army thinks is right. Nevertheless, this is the judgment that the Secretary of Defense has to make, and we made it, and there it is.

Mr. Teague. Will the gentleman yield to me for one question?

Mr. Mitchell. Yes.

Mr. Teague. Is this comparable to the Jupiter, Thor, and other missiles as to beginning production at a certain time?

Secretary McElroy. It is a much more complex thing, so the scientists tell me, Mr. Teague. There is no problem now about putting a missile into the air. In other words, the missile portion of this is not the problem. The problem is the computer. The problem is radar. And the problem is discrimination in all of the clutter that is up in the atmosphere when this comes through, to pick out the thing that is the warhead and not go chasing something which is a harmless piece of exploded missile, for example.

Mr. Teague. So it is not comparable?

Secretary McElroy. No; it is much more complex than anything that we have produced up to this time in the field of weapons.

Mr. Fulton. And at the present time if they blasted the second stage of an incoming ICBM into 30,000 pieces, you do not have the technical know-how developed yet as to how to discriminate and select the ballistic missile which is the real one?

Secretary McElroy. That is right.

Mr. Fulton. And unless you have that, there is no use putting the system into operation?

Secretary McElroy. That is one of the technical problems.

Mr. Mitchell. I realize the seriousness and complexity of the problem you are confronted with, and I am not trying to be at all critical, but I am trying to see that this matter has been dealt with solely on the merits of the development of the Nike-Zeus system.

Secretary McElroy. Very good.

Mr. Mitchell. Now, in connection with the questions by the gentleman from Texas, Mr. Teague; you say it is not comparable with the Jupiter and others. As far as the missile, itself, is concerned: Is it more or less considered without bugs and defects?

Secretary McElroy. I think that is a fair statement.

Mr. Mitchell. So the problem must be as to these other components.

Now, as to these other components, have not the Army and your scientists said, insofar as the R. & D. on the other components is concerned, everything is proceeding normally? There actually have not

been any things to develop that have not been swiftly overcome? Is that correct?

Secretary McElroy. If you mean are we moving as they think we might move on a problem of this complexity, you might say that; but they don't know whether you will ever find the answer to some of these things.

Mr. Mitchell. The Army feels very strongly that they have found the answer.

Secretary McElroy. That is right, but also this is a situation where I think you would expect that the Army might be a little bit more optimistic than a more objective group of scientists.

Mr. Mitchell. I don't know what you mean by a more objective group of scientists. They seem to have been mighty objective in the past, Mr. Secretary.

Let me close with one question.

Secretary McElroy. Well, would you not concede that somebody that is about to engage in the deployment of a weapon and has it under development as one of its own projects is more likely to have a broadly optimistic view about what it is going to have than somebody who comes in as a completely objective reviewing agency?

Mr. Mitchell. I would think, Mr. Secretary, that those working on the project would know more about it and probably would be more objective than the reviewing agency from the outside, and I would think this, too: Anyone who recommends a project of this magnitude with the fervor that they have certainly should be given every consideration, because this involves a lot of the taxpayers' money. Of course, we are the guardians of defense, and the purse, and so on——

Secretary McElroy. They are being given every consideration, Mr. Mitchell.

Mr. Mitchell. I am glad to hear that. So I propose asking you this:

Just what effect did budget matters, money matters, have in entering into the decision?

Secretary McElroy. Not at all. This is a top national priority program. If we had known which way to go, we would have moved out to produce. We do not know which way to go, so we are not recommending going on to produce. What we are doing is substantially increasing the amount of money being spent on Nike-Zeus, in research and development, in the Department of Defense Advanced Research Projects Agency, as well as in the Army. I think it is evidence of the fact that again the best scientific advisers we have say that this is the most that you could effectively spend, so we are giving it everything we know how, because we believe that this is a program that must be pursued with top priority.

Mr. Mitchell. Thank you, Mr. Secretary.

The Chairman. Mr. Secretary, before we adjourn, I want to ask you this:

How did the Department divide; did it divide along service lines on that point?

Secretary McElroy. Do you mean on the overall appropriation?

The Chairman. No; on the question of the Zeus, the use of the Zeus for a defensive weapon and in production at this time; did the Department divide on service lines? You referred to the Army as being a supporter of the program. What about the Navy?

Secretary McElroy. Well, the Army has been assigned the deploying responsibility for this weapon. The Navy, the Air Force and the Chairman of the Joint Chiefs of Staff all in reviewing this program recommended against proceeding with the manufacturing phase of it.

The Chairman. So the Army stood out alone as supporting the beginning of production?

Secretary McElroy. That is right.

The Chairman. Now, let me ask you this: This afternoon some of the members would like to ask you questions. What time could you return?

Secretary McElroy. Well, I can be firm on 3 o'clock.

The Chairman. Three o'clock.

Secretary McElroy. If it needed to be before then, it would be chancey, and I do not like to ask you gentlemen to wait for me.

The Chairman. What about General Twining. We have great respect for his ability and judgment, too, and we would like to have him back.

General Twining. Very well.

Secretary McElroy. Well, I can be firm as to 3, then, if that would be satisfactory.

The Chairman. Very well, then the committee will adjourn until 3 o'clock this afternoon.

(Whereupon, at 12:32 p.m., the committee recessed to reconvene at 3 p.m. of the same day.)

AFTERNOON SESSION

The committee met at 3 p.m. in the caucus room, Old House Office Building, Hon. Overton Brooks, chairman, presiding.

The Chairman. The committee will come to order.

When we recessed I had recognized Mr. Mitchell and he had completed his interrogations and Mr. Baumhart was the next one. However, he is not here.

Mr. Quigley is not here either, is he?

Mr. Sisk is here.

Mr. Sisk. Mr. Chairman, I have just a few questions here. I hope to make this as rapid as possible.

Mr. Secretary, we appreciate very much your coming back this afternoon to discuss these matters. I will tell you, my questions primarily will concern R. & D. funds and their breakdown and distribution and so forth because, as I understand, that is part of the jurisdiction of our committee—having to do with research and development and scientific matters, both in the field of civilian as well as the military.

Now the first question I would like to ask, Mr. Secretary, is a general question of this nature: Are you satisfied with the amount of money, or let us say the proportionate share of the money, that will be called for in the 1960 budget for the military as compared to the civilian agencies?

Now to clarify that question a little bit, I have in mind, of course, the money that will be made available to NASA and its affiliated or-

ganizations such as the National Science Foundation and so on—having to do with civilian or peaceful space exploration, as against that having specifically to do with the military.

Now I would like to have you comment on that a little bit, as to what you think of the allocation of funds between these various agencies, looking ahead to the 1960 budget.

Secretary McElroy. As I believe I indicated this morning, Mr. Sisk, I believe really at this stage of the research and development activity in outer space almost everything that is done, whether by the civilian agency or by the military, has some importance from a military standpoint because there is so little known about that that you would have to do the fundamental things of understanding the environmental problems like radiation and things of that sort, whether there was any civilian interest in it or not. You have to do it for your exploration of the military possibilities.

But I would like to answer your question, if I might, in terms of the overall combined civilian and military because to me it never has been terribly important whether a civilian agency or a military agency did this work provided those things that were needed for the military were done.

That is the reason to me it makes more sense to answer your question in terms of the composite program of the two agencies and I would like to talk to that point, if I might.

I think that the combined program of the two agencies is a sound program from the standpoint of our military objectives for outer space, and I refere there—our No. 1 objective falls in the area, really, of communications, surveillance, and that kind of thing.

That program is under vigorous advancement. The rest of the program which seems to have some importance from a military standpoint, but somewhat lesser than those first two, seems also to me to be progressing at an adequate pace—probably not as far as it could, but as fast as I think it needs to. My net answer to your question is that I think it is a good program for the military necessities.

Mr. Sisk. I think in general that is responsive to at least a part of what I had in mind.

That thing that sometimes I get a little concerned about, as I am sure other Members of Congress do, are statements by the individuals who say well, No. 1, the most important thing before our country today is security—national security and national defense and all the things that go with it—and that therefore we should, at least for the time being, concentrate almost 100 percent in this field—I am speaking now of research, scientific development, and so on—in the military fields, both as to its application from the standpoint of space, as well as the ballistic missile and so on—anything that is involved in that realm of thinking at all, and that what we are doing is possibly tending to hurt our defense posture by this split, or by this setting up of a new agency exclusively for, let us say peaceful exploration, as against ARPA having to do, let us say, with the military.

I was interested in your own thinking on that subject because I think it is important that we do realize the rather pressing situation that we are faced with in the military field to make certain that we maintain adequate security.

Secretary McElroy. I consider it the responsibility of the military in this overall programing of outer space to make certian that those

things which are specifically military objectives are taken care of one way or the other either by NASA or by ARPA—again as I said earlier that division seems to me to be less important that the assurance that the job is being done by competent people in one or the other.

Mr. SISK. You feel that from the standpoint of economy—I am speaking now of economy in time and economy in money—that this is being just as well done, or possibly better by the new agencies—or a multiplicity of agencies—as it would by simply concentrating upon ARPA at the present time?

Secretary MCELROY. I would like not to see a multiplicity; but I do think the two agencies combine, and I think there is a very definite advantage in having part of this done by a civilian agency which gets into the area of international cooperation. It is very difficult to get international cooperation with an activity that is run by the military because the military has to be very closemouthed about what it says. A civilian agency can engage in cooperative effort internationally and I think over a period of time we do hope that quite a good deal of this outer space work will have international participation.

Mr. SISK. Now, Mr. Secretary, another question that I would like to discuss with you for just a couple of minutes has to do with certain statements that our committee has heard, both I think actually in committee as well as by individuals who are concerned with this problem—having to do with the constant review and re-review of various programs.

It seems to me there is a feeling—and I am sure this is true among many of our military people—that if they can be given a job to do, a project, and then for example set it up for let us say a 2-year period in time, or at least a long enough period in time where they knew they can go ahead and proceed, that we could much more expeditiously do the things that are necessary in defense. Of course that applies also to the peaceful projects in space.

I wonder if you would comment on that. I know that certainly in, let us say, conversation with the many military people, they feel that this constant review and re-review—and here again, I realize the Congress is as much guilty of this as, for example, DOD, or anyone else, and this is not to be critical or create controversy—I am concerned about this fact, though, that we have a constant change in direction, many times, in some of these projects.

Secretary MCELROY. I think this is something that if either you or I were operating these programs we would both feel a lot of sympathy with.

Mr. SISK. That is right.

Secretary MCELROY. I do not think we could fail to.

However, we cannot proceed in government quite as we might do, say, if we were in industry. In industry you can kind of say, "This is what we will do," and we will press onward with it.

We have many people in government who want to keep in touch with this and need to have a somewhat continuing understanding of this which the Congress itself or the appropriate committees of Congress may feel is obligatory on them for the carrying on of their responsibilities.

In addition to that, however, in this field of military technology, the speed with which these fields of science have been moving has been so vast that it really is almost necessary to have periodic reviews of programs in order, on the one hand, to see that certain types of technology have not overtaken certain ways in which we are proceeding, or that we grind into a given program some new information which has come along since the program has been charted and set out in the way in which you say—maybe for a 2-year thing, we hope, but some variations in direction make a great deal of sense.

I know that there may be too much of this in certain cases but I expect also that government being what it is we are going to have quite a little bit of that indefinitely just in order to take care of the people who feel as if they have to do a certain amount of auditing of what we do.

Mr. SISK. Of course I think that is one of the prices we pay for democracy and I think it is worth the price. As a matter of fact, I think it is worth any price we have to pay. I think there is not any question but what from the standpoint of getting these kind of things done maybe—maybe a dictatorship would be more economical in time and money, possibly, but certainly we would sacrifice that to something far more important.

Secretary MCELROY. This integrated direction we hope will reduce the amount of that by putting it in one organization.

Mr. SISK. Do you feel that it would be feasible at all to consider, for example, money, the appropriations for these specific types of program in a 2-year cycle rather than a 1-year cycle? Do you feel that would speed it up; do you feel that the taxpayer would get, let us say, more "bang" for the "buck"?

Secretary MCELROY. Quite a lot of projects for which money is appropriated are appropriated on a more than 1-year basis.

Mr. SISK. A no-year appropriation, some of them.

Secretary MCELROY. That is right.

Mr. SISK. Do you feel we could exist by a—for example, what I had in mind is a definite 2-year cycle on various programs rather than what you might call no-year funds. Put them on a 2-year cycle.

Secretary MCELROY. From the standpoint of administration I am sure we would rather have appropriation on a 2-year cycle rather than on a 1, but I do not believe you men in Congress are going to give it to us.

Mr. SISK. I would doubt very seriously, Mr. Secretary, that this would come to pass. On the other hand, we are constantly seeking ways in which we might be able to do a better job to speed up our endeavors and particularly in research and development fields, and this is one of the ways—certainly many military people have said to me in off-the-record conversations that they felt it could be done. There may come a time when possibly it will become a necessity; I do not know.

Secretary MCELROY. We do get a certain amount of this, though, Mr. Sisk, through the no-year funding and if we do full funding as we do in the military, with most or at least many of our projects, we get the equivalent of what you are talking about which is the flexibility of long-range planning and financing.

Mr. SISK. Just one last thing, Mr. Chairman, that I would like to discuss for just a few moments, and that has to do with your—that is, the Department of Defense's apportionment of the moneys in research and development to the various services. You do that according to a formula, is that correct? I mean one which you have used over a period of some number of years?

Secretary MCELROY. No, the services——

Mr. SISK. I am speaking now of the Army, Navy, and so forth.

Secretary MCELROY. The services have their own budgets, and they recommend certain proportions of the budgets to go into research and engineering. They recommend a certain proportion of all that to go into basic research and these are all in relationship to certain projects. The whole thing is specific to certain objectives that they have for their research and development programs. So that it may fall out that the spending ratios have some reasonable comparability from year to year. I would be surprised if that were true. I personally looked at that to find out.

Mr. SISK. The overall appropriation—now, the total appropriation for each service—for example, for the Air Force, for the Navy, and for the Army—then, is worked out on this formula and then each service determines the percentage of that which it shall put into research and development; is that what you are saying, Mr. Secretary?

Secretary MCELROY. No; even the first part—at least since I have been around, Mr. Sisk, we do not take any percentage figure for each one of the services against a total, and I think that would be wrong as a method of procedure.

Mr. SISK. I do, too. I want to agree with you there. I have heard statements that would indicate that is being done. You say that is not being done?

Secretary MCELROY. Well, it certainly was not this year, and I know about this year because anything that happened this year is entirely on my neck. Last year was partly mine and partly my predecessor.

However, nobody has indicated to me that in recent years—and certainly it did not happen this year—that there was any percentage figure put against the total amount of money that we had in mind as an objective for spending and said "Because of this percentage application against this total you, Army, have this; you, Air Force, have this; you, Navy, have this."

That was not done and, in my opinion, it should not be done because what should be done is to do whatever is needed and let it fall among the services the way it happens to fall.

Mr. SISK. I agree, certainly, with that statement, Mr. Secretary, and I would hope that that is the way it would be done.

As I say, I have a great deal of confidence in you and in the Department of Defense and I know you know far more about this than I do, certainly; but I am going to say quite frankly that I have been concerned, and am still concerned, about the percentage of the dollar for research and development that is being given to the Army as against what is being given to the Air Force. Quite frankly, I am concerned about that. And that is one of the reasons I was asking these questions.

Secretary MCELROY. Again I would suggest, Mr. Sisk, that you push at it—not from the standpoint of percentage so much as what is

not being done in the area of Army responsibility that ought to be done. Push at us in that way, I would suggest, rather than: Is it getting enough percentage?

Mr. SISK. As I say, I am not saying these things to be critical. I realize you have a very big job. But, certainly, as we see these various programs in research and development taking place, and see the amount of money that apparently is being given to do one job as against another—as I say, it has caused me to develop quite a bit of concern whether or not the Army, in view of its responsibilities in our overall defense, is getting its proportionate share of the funds needed in this field.

Secretary MCELROY. I would like to suggest—because there is a question where I think you have a right to be satisfied—that if you will give us about another 30 days for Dr. York to get organized in his new job, this is exactly the kind of thing where I think it would be well for you to spend a few minutes with him. Then if you wanted to start with the Army, that would also be all right. Then you get what concern the Army has about efficiency.

But I believe that you will find—I know there is no conscious discrimination against the Army, and if there is any greater underdog there than someplace else, it would be solely because of some lack of judgment decision someplace along the line by, probably, myself.

Mr. SISK. Thank you, Mr. Secretary and General Twining.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. Thank you, Mr. Chairman.

Mr. Secretary, I want to thank you for coming back this afternoon too. I am sure there is no one here who doesn't agree that you are sincerely interested in the defense of this country, as is each and every member of this committee. This is the primary consideration and not a question of balancing the budget. There are many things being written to the contrary, and with this thought in mind, I would like to discuss an article in the recent issue of Newsweek, which has a remarkably fine likeness of you, Mr. Secretary, on the cover. There are a few thing which were written here that I thought you might like to discuss in open session.

I am interested in a subarticle within this article which says:

"How much do we know about the military?"

And then in Russia:

They have gone into detail and demonstrated that at some time in the past our Central Intelligence Agency hasn't been able to do the job. They demonstrate this.

I would like to put this in the record.

Secretary MCELROY. You say that they have not been able to do the job?

Mr. WOLF. They have demonstrated, where there was a difference of opinion, that it was the Central Intelligence Agency-produced intelligence that proved to be in error when compared to what actually happened.

I would like to have your opinion on them as I read each one of these to you, if I may.

It says that in A-bombs the United States intelligence experts predicted the Russians certainly couldn't explode an atomic bomb before 1951, and probably it would be a year or so later.

To the astonishment of these experts the Russians held their first atomic bomb test in 1949.

Here was one of the first places where our intelligence has failed us. Then they went on to Korea.

The North Korean Communists had staged a carefully planned series of border raids and had made repeated reconnaissance in force. U.S. troops in South Korea had no inkling that the Reds planned an all-out invasion. For several hours after the June 25, 1950, attack, intelligence agencies still thought it was another border raid.

Our intelligence failed us there.

The Mig–15 came as a great surprise to the U.S. Air Force in Korea. It was faster than our F–86, could fly at higher altitudes, and was more heavily armed. Air Force intelligence said the Russians could turn out no more than six Mig–15's a month by hand. The Russians actually built 10,000 of them.

I am reading directly from the article.

H-bombs—

High altitude bombers, planning for AEC intelligence, scooped up air samples that detected the first Soviet thermonuclear explosion in August 1953. Intelligence chemists analyzed the radiations of the Soviet blasts, confirmed the theories of physicist Edward Tellier and thereby speeded the detonation of the first U.S. explosion of an H–bomb several months later.

Then on Red bombers—

The Soviets put their Bison bomber, similar to the B–52, into production 3 years sooner than U.S. intelligence expected. The Defense Department got worried at the displays of Red bombers, stepped up B–52 production, built the DEW line across Canada, and rushed through antiaircraft missiles. While the United States was concentrating on bomber defenses, Russia got busy on missiles.

Then on the question of missiles—

As early as 1954, intelligence gained through technical literature, traveling scientists, and industrial statistics showed that the U.S.S.R. had launched a major program to build missiles. A huge Air Force radar station in Turkey picked up the Soviet intermediate range missile test by monitoring the upper atmosphere. The same station detected the first successful intercontinental missile heads in August 1957.

A vast network of monitoring devices in the Near and Middle East also keeps constant watch on sputniks and Soviet military and commercial missions.

The other day I referred to this article to one of the gentlemen here, and he said this was not true. He didn't use that exact expression, but he implied there was no truth in this.

Now, Mr. McElroy, this is the sort of information the great mass of American society has, and the only place they can go for information. And on the basis of what they read in our magazines and newspapers they are forced to make decisions, and these decisions many times are expressed to us.

I would like to have you now comment on this and how the CIA equates its material, and whether we can now consider our CIA intelligence much more significant. Or are we possibly as far off today on missiles as we have been in these cases?

Secretary McElroy. The specific individual instances you give I would be unable to comment upon because I don't have the specific information. I think it would be well if you did want to ask those particular questions of someone, that you do it sometime when Allen Dulles is before you in closed session. I think he could comment on these to your much greater satisfaction than I could.

Mr. WOLF. You see what I am trying to say, Mr. McElroy? The American people have been exposed to this magazine and many other articles. They are trying to make decisions. All I want to know is do we have new information that makes our CIA more reliable to you as the leader of our Defense Department?

Secretary MCELROY. We think we have increasingly good information. We think, as General Twining pointed out, that there are still soft spots in our information because the Russian has been remarkably good at avoiding leaks of information. This he can do because of his rather summary execution of people who are careless with information, whereas, the processes of legal retribution grind a good deal more slowly in this country and a good deal more—well, a good deal less inexorably.

The principal part of what I think I should say in response to your overall question, however, is that we have very recently again questioned for the members of the Joint Chiefs of Staff and for the top-level people in the civilian side of the Department of Defense just what the quality of our intelligence is. Because it is on this that we base many defense decisions. And our belief is that the information we have is good information and information on which we can predicate programs of our own, with confidence.

Now, I know that that isn't quite the answer you would like, but that is certainly all the answer I can give you here in public session.

And I would also urge that in getting at the more specific elements of intelligence that it be done in closed session, and that the person who really gives you this should be the man who can give it to you with the greatest authority, who is the Director of the Central Intelligence Agency.

Mr. WOLF. Then let me pursue another idea along this same vein: Would you recommend that there be some sort of a formula for the news media, the news gathering people to use, so that we don't have this unfortunate conflict which provokes many people?

Secretary MCELROY. I am not optimistic about that being very successful.

I would like to do it, Mr. Wolf, but what so often happens—and again we were talking about democracy and the freedoms we have and how important we think they are, and I am one of those who thinks they are important—we have people who interpret figures differently and also some people, who are important people and very intelligent people, decide that they have better information than the Government has. If they want to circulate this information, there is nothing I suppose under our kind of a system that could put those people in any kind of a straitjacket.

I am not saying that there is anything irresponsible about any of these people, and I don't mean to suggest that, but people are simply inevitably, as individual people, going to interpret the same kinds of information differently, and some people will take hearsay information and give it a good deal more weight than we, of course, can do in the military. We take hearsay evidence, of course, but we only add it up to more hearsay and more and more and more and put it also with other types of information for us to get a total overall intelligence estimate.

40691—59——30

Mr. WOLF. Then there is another little box in here in very small print:

> Contrary to widespread opinion, the Air Force never has had 24-hour air alert; bombers in the air ready to attack, that is.
>
> General Nathan Twining, head of the Joint Chiefs of Staff, told a House committee last week it isn't necessary. But General Power, who actually runs SAC, told a Senate committee he would like to have a number of loaded bombers in the air at all times.

This is in very small print in this article, but if we agree with what we said this morning, agree that SAC is our first line of defense, I thought you might like to comment on this question of whether or not we need something here.

General TWINING. There is no requirement today for an airborne alert. In fact, if we tried to do it, it would hurt our capability. We do have a ground alert, as you know. About 30 percent of the aircraft are on the ground, bombed up, ready to go. We expect to have at least 2 hours' warning in the present threat from Russia, so why dissipate our forces and put them in the air and wear everybody out, including the airplane and the crew, and take a risk of flying these bombs all over the country?

I think the day may come, and not too far away, maybe—in the next few years—where we might want this airborne alert, so we are working on it. But as of today, no, there is no requirement for it, and the Air Force doesn't want to do it yet.

Mr. WOLF. You didn't have a chance to answer that in this article, sir, and I wanted you to have this chance.

They also have some statistical data, here, on comparisons between Russia and the United States. I don't want to go into this, but I noticed that Mr. Fulton and I, have different statistics. He said we have 443 submarines, this morning—the Russians have—excuse me. And we say—no—that is right, 200.

Mr. FULTON. Will you yield?

Who is "we"?

Mr. WOLF. The U.S.S.R. This article.

This article, adding up military power, says that the U.S.S.R. has 200 submarines, and you said they had 443. This is an interesting question.

Is this a new and later figure, the 443?

I see. It has been clarified for me. It is a total of two figures here. There are about 450 submarines in two classes.

Secretary MCELROY. We don't want to be in the position of talking over this figure in open session in any case. I think any of you gentlemen who want to use a figure can use one, but we give out the figures which are the final intelligence estimate figures, and we can only give these figures in closed session, Mr. Chairman.

Mr. MCDONOUGH. Will the gentleman yield?

Mr. WOLF. I yield for a question.

Mr. MCDONOUGH. Mr. Secretary, in the transmission of information from the United States to Russia—and they evidently have a very broad and widespread spy system operating in this country—did the decision of the Supreme Court denying the Secretary of State the authority to screen passports hurt our situation to any extent and in your opinion should that be corrected by legislation?

Secretary MCELROY. I am confident it didn't help us a bit.

Now, how badly it hurt, I don't think the Secretary of State would know, and I don't know, either. In my opinion there should be some right of restriction against those people whose records make it clear that they constitute a security threat against this country.

Mr. McDonough. In other words, it is a one-way street?

Secretary McElroy. I don't see how we can be helped by this kind of situation.

Mr. McDonough. We don't enjoy the same privilege in Russia that they have here.

Thank you.

The Chairman. Along that same line: Is our inability now to release known Communists in the executive branch of Government, due to the Supreme Court decisions, jeopardizing or hurting in any way our security? Is it making it more difficult to carry on a security system there, free of leaks?

Secretary McElroy. I would say again in this instance, Mr. Chairman—and this definitely can only be on the negative side of the ledger—we are working with the Department of Justice to see whether something can be done perhaps to repair this situation.

The Chairman. In other words, it is making it more difficult for us to carry on our defense because we can't discharge Communists under the Supreme Court decision?

Secretary McElroy. Inevitably, sir.

Mr. Fulton. Will the gentleman yield?

Mr. Wolf. One more question, but go ahead, Mr. Fulton.

Mr. Fulton. My figure is 500 Russian submarines. Taking off the obsolescence and adding on the new submarines gives me a figure of somewhere between 440 and 450.

That is my own figure.

Mr. Wolf. Thank you, Mr. Fulton.

The other question that I was interested in, Mr. Secretary: In most of the public data that we have, in the papers, we never read anything about how we equate what Great Britain, for example, Canada, the continental countries—how we fit this defense mechanism into our own. Can we do a little of that in open session?

Secretary McElroy. I don't think we can, as much as we would like to, Mr. Wolf.

But in the posture briefings on which General Twining spent a great deal of time in the early part of this session of Congress, he gave this presentation on six different occasions to committees of Congress. He made very clear that we were comparing the capabilities of the United States and its major allies, rather than the United States by itself, because our strength is a strength not only of ourselves but of ourselves and our allies around the world. And this is also true to a considerable extent of Russia. Russia's strength is a combined strength of Russia, China and its European satellites. Whatever the loyalty of those forces are, you have to judge for yourself, and we apply some discounting against them, as I am sure you would do. Certainly, the satellite countries have less dependability for Russian purposes than the Russian forces themselves.

But in our posture briefings, which are the considerations of the relative strength of the two worlds, we certainly consider not only our own strength but the composite strength of the United States and its allies.

Mr. WOLF. And along this line, do we work with any of these countries on some of this basic research? Do we work back and forth? Do we let them take a field and develop it and coordinate our activities?

Secretary MCELROY. We work very closely with certain of them, and very effectively.

As I indicated somewhat this morning, in response to a question of I believe Mr. Osmers, the British have made remarkable advances in certain types of things like radar, like aircraft gas turbines, like the canted deck on an aircraft carrier, and things of that sort, which we ourselves have been very pleased to adapt to our own purposes, and I hope they have gotten some things from us.

Mr. WOLF. I think there are others who have some questions, so I will quit.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Karth.

Mr. KARTH. Many of our top scientists and some of our celebrated rocketeers have felt and openly expressed their opinion that the Russian missiles are superior to ours not only in the field of propulsion but they are also superior to ours in the matter of accuracy.

For example, General Phillips was recently quoted as having said that one of their missiles is worth two of ours.

Do you concur in this thinking of his and that expressed by some of our other scientists or what is your position?

Secretary MCELROY. We think that the best that we can give to the Russian is equivalency with ours. Whether that is too generous, we don't know. We have no evidence that there would be any superiority of his missiles to our own.

General Twining may want to comment on that.

General TWINING. No.

I agree with what the Secretary said. We give them the capability that we have, and we have no information to indicate they have any better capability.

Our intelligence doesn't give us that.

Mr. KARTH. Give me some idea then of how accurate and how reliable our missiles really are by answering this question. If you feel you shouldn't answer in open session, it is all right with me.

If all of our Thors and all of our Jupiters had been aimed at a target, how many of these Thors and Jupiters would have hit the target?

General TWINING. That gets into a pretty secure area. I would rather not answer that. I would be glad to give it off the record to you at any time.

Mr. KARTH. All right, sir.

Could I see you after the public session? I would like to ask you that.

General TWINING. Be glad to; yes.

Mr. KARTH. I am one of those who feels very strongly about psychological warfare in addition to feeling very strongly about a shooting war. It is apparently the consensus that we don't have a great deal to worry about insofar as a shooting war is concerned for the next few years or so, but at least sentiment has been expressed that Russia is not in a position to give us push-button extermination—let

me use that phrase, if I may—and as a result of that we don't have too much to worry about insofar as a shooting war is concerned. But as I said, I am interested in psychological warfare, too.

The war, for example, some people believe could be won without a shot being fired. The Russians have been first on several occasions now, and as a result of that we have gone down the scale in public opinion insofar as phychological warfare is concerned.

Now, the question I have in mind is—because public opinion all around the world has a great deal of influence on the standing a nation has insofar as their potential military ability or world leadership ability is concerned: Do you feel that if the Russians are the first, for example, on the moon, that this will have a tremendous adverse effect on the whole world situation, and if they are, that we may easily slip down another notch or two in the eyes of the freedom-loving countries of the world?

Secretary McElroy. I think it would be an advantage to Russia in this whole war. I personally feel we have gone past the point where we get quite so hysterical about the things as we did as a country last fall, or a year ago last fall. In fact, the President has frequently said that when you have in the world several nations with substantial scientific capabilities, it will not be possible for any one of those countries to make all of the initial discoveries. And what you find is probably what you have found in the last year or two. Many of the discoveries in various types of science are firsts for this country.

You will find from time to time that there will be some on the part of other countries among our free world allies, and you will find some that are made in the Communist countries.

Now, of course, I don't like this any more than you do, but it is a fact of life, I am afraid, that we can't keep knowledge from being developed by countries that are willing to put their minds to it the way the Russians have been willing to put their minds to teaching themselves and learning in every way they know how.

I think that is one of the facts of life we will be up against for some time to come.

Mr. Karth. Mr. Chairman, if I could try to get a little more specific answer here—I don't know if I follow you all the way through—your elaboration on the answer, that is. Do you think we will lose considerable prestige in the eyes of the freedom-loving countries and in the eyes of the world if we are not first on the moon, or let me rephrase it, if we followed Russia on the moon?

Secretary McElroy. I think it would be negative, but if we were first on the moon and the week after that they were first on Venus, I don't know how it would balance off. This is the kind of thing I am trying to say may go on. Maybe they would be the first on the moon and we would be the first on Venus. If this took place in a period of about 7 days I don't know who would gain by it.

Mr. Karth. Well, some of our scientists are saying if we don't make considerable progress—and many have said if we don't surpass—let's take the form: "If we don't make considerable progress in this field in the next 12 months, we have lost this battle."

Does this express your sentiments?

Secretary McElroy. No, it doesn't express my sentiments. I think that is an extreme statement.

Mr. KARTH. Do you concur in that?

Secretary MCELROY. No. I would like very much to get to a place where we could be first with all the space enterprises. This is certainly the thing that I would find desirable.

Mr. KARTH. On the basis of how we are progressing today, do you think that we are quite substantially catching up to Russia in this whole field of missiles and space?

Secretary MCELROY. I think, as far as missiles are concerned, at the present time we have as sophisticated a missile as Russia does. In outer space, I believe he has a better run on outer space than we do, because he has a bigger booster and he can put a bigger load up in the air.

To the extent that the big load permits a greater amount of equipment, I think he will have superiority until we are successful in creating a very large booster of our own.

Mr. KARTH. Do you feel that a great deal of scientific advancement comes about as a result of basic and advanced research?

Secretary MCELROY. That is very much my belief.

Mr. KARTH. Is this the area where we have fallen behind Russia and the result has caused us to be second?

Secretary MCELROY. I think the place where we fell behind was in the size of the booster.

Mr. KARTH. This was brought about by lagging in basic and advanced research, wasn't it, sir?

Secretary MCELROY. I don't think so, no. You could have had a big booster if you decided you wanted to go the direction of earth satellites. We don't know that this is true, but we think it is quite likely that the Russian got into the very large booster more or less as a byproduct of his having decided to go down the missile road much earlier than this country did. His initiation of his effort was way ahead of ours, as I suppose you know. At the time that he was initiating his effort, the warhead that he would have had to lift the 5,500-mile distance was so heavy that he had to produce a very large booster in order to get it that far. By the time we got underway with our effort on a long-range missile we had determined that we would make a warhead of ample destructive power with so much less weight that we did not need the big booster in order to boost our ICBM the full range into enemy territory, so we produced a booster which was of adequate size to lift the lighter warhead the distance that was required.

We don't know this, but we think it is not unlikely that the creation of a large booster, which later gave him this special capability in the field of outer space, was somewhat of a byproduct of the timing of his initiation of his ICBM development.

Mr. KARTH. I think the concern of this committee, Mr. Secretary, is that we catch up. That is one of the primary concerns of this committee, for the security of the United States. I certainly know that you appreciate that, and we know you are very aware of it, and we appreciate the position that you are in, too. We know that you are doing everything that you think is best for the security of the United States.

There are, however, a great many scientists who believe that we are not spending enough money in basic and advanced research, and

I am kind of inclined to go along, because you can't start at the second stage of a rocket; you've got to start at the first stage, and I think this is true in the whole scientific field. You've got to have good, basic and advanced research, and if you don't get the money to do it, you are never going to get to the second stage.

In your opinion, sir, do you feel that there has been a sufficient amount of funds in the basic and advanced research fields to cause this necessary knowledge to come to our scientists?

Secretary McElroy. I was replying to a somewhat similar question this morning by saying that I would go along with a man whom I respect very highly in this field, who is Dr. Killian, who recently has made a talk in which he deplored the insufficiency of basic research expenditures in this country. I agree with him.

In fact, one of the things that I have done here in the Department of Defense budget was to make certain that in the course of any searching that go on for ways in which money might be discovered for favored programs there be no impingement on the basic research program. I can assure you that that has taken place.

Mr. Karth. How much more money, sir, do you think should be spent on basic and applied research; do you have any idea?

Secretary McElroy. I have asked this question of some of my friends, like Dr. Killian. I don't want to quote him, so I will simply give it as my own opinion. This is one which is more dependent on the number of qualified scientists in this very high level of imaginative scientific work than any other thing, because it isn't money for buying equipment, it is money for financing people, and there is a strictly limited number of people who have minds that are good enough to contribute to the advancement of basic research knowledge. I don't know how much, but I don't think it would be a very large sum of money in the terms in which most of us think as we consider such things as space or military effort.

The Chairman. Any further questions?

Mr. Karth. You think it would be in millions of dollars?

Secretary McElroy. It would be in millions of dollars and I don't think very many tens of millions of dollars. Of course, I don't want to discount the importance of $10 million, it is very important.

But nevertheless in these days we talk about $10 million not infrequently.

Mr. Karth. Are we putting sufficient funds in engineering research on the Juno V to insure its success?

Secretary McElroy. On that one specifically I wouldn't be able to answer you, I am sorry to say, but I will be glad to look up that point and report back to you, if you would like.

(The requested information is as follows:)

In response to a question respecting the adequacy of funding for the Juno or Saturn 1½-million-pound-thrust engine, contained on page 128–A, the following information is provided:

The Director, ARPA, previously testified before the committee on this subject. He has indicated that research funds for the Juno project are adequate and that the Director, Army Ballistic Missiles Agency, has no further request pending for additional research funds. With respect to the development program, ABMA will submit a proposal for an increase in production of vehicles from the presently approved 4 to a total of 16.

The Director, ARPA, has previously testified that upon receipt of this technical proposal and subsequent to the determination of appropriate missions as

between the Department of Defense and NASA for additional vehicles, decision as to further action will be made with these decisions to be reported to the House Committee on Science and Astronautics.

The Director, ARPA, has also indicated that insofar as DOD is concerned, an increase in vehicle procurement from four to eight may be feasible; however, missions for the subsequent eight proposed for production by General Medaris have not yet been identified. Such decisions cannot be made prior to the completion of joint discussions between NASA and ARPA. Such discussions cannot occur until receipt of the technical program proposal from ABMA. This proposal is due to be received by DOD on or after March 16.

Mr. KARTH. Fine.

Thank you, Mr. Chairman.

The CHAIRMAN. Dr. Hechler.

Mr. HECHLER. Thank you, Mr. Chairman.

I think I have a clearer understanding of the nature of the reasons for the administrative structure aspects of the missile and space program. Yet what deeply concerns me is that the American people are still engaging in a hue and cry for a single space agency and for an elimination of competition and duplication in the whole missile and space program.

Now, obviously, the system which you have, which has satisfied you, I presume you wouldn't want to change. Now, sir, you have had considerable experience in private industry in persuading people to do certain things. I wonder, sir, if you have any ideas as to how we could clarify this whole question for the American public. I do believe they are deeply disturbed and deeply concerned. This is the first question asked me when it is learned I am on the Space Committee: Why do we have so much duplication?

Secretary MCELROY. I don't believe I know any better way for the public to obtain information than from people like yourselves and myself. We are governmental people, and the people to whom the voters look for enlightenment. I appear once in a while. Like Sunday, I am committed to appear on a program, and I presume you gentlemen appear there from time to time. You don't always get the questions that you would like because the questions that you get are not only your judgment of what are good questions, but also the judgment of your inquisitors. I am talking now of the kind of program where you answer questions someone puts to you.

The other way to do has been mentioned here this morning. In the U.S. News & World Report there is a reprinting of certain of the endeavors that some of us make to answer questions of the American people. News Week carries some, and so on.

Mr. HECHLER. Are you disturbed by this reaction? Are you concerned about it?

Secretary MCELROY. Well, I am concerned to have a misunderstanding of what seems to me to be a good public program.

Mr. HECHLER. You do not believe, however, that the concern of the people is sufficient to cause you to alter in any respect your administrative organization in order to make it more simple, clear and direct, and understandable to the American people?

Secretary MCELROY. Well, I wasn't aware of the depth of concern that you have felt, I take it, from your constituents. I do think this, that any relatively new agency of Government does have a certain amount of time that it needs to shake down with the public, as well as with its own operations. I would hope there would be no precipitant action to do anything except to try to encourage better public understanding of just what is going on.

Mr. HECHLER. Let me ask one final question. Quoting Admiral Hayward, in his appearance before this committee: "After a year of furious U.S. activity, I sincerely conclude that U.S. supremacy in space science is threatened, not by the lack of talent, but by our skill in bureaucracy.

"Personally, I feel we should have one U.S. space program."

He went on to describe the analogy of the work of the Atomic Energy Commission to advocate such a single program.

Secretary MCELROY. I disagree with Admiral Hayward.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Thank you, Mr. Chairman.

Mr. Secretary, this morning you referred to the Russian guided-missile range and said it was limited to something in the vicinity of 3,500 nautical miles, and that they had shown a capacity to hit targets within a good area in that missile range restriction, but that they would need something in the vicinity of 5,500 nautical miles to attack this country.

Now, if we are to take the Chukotsk Peninsula and draw an arc of 3,000 nautical miles, we will include all of Alaska, and a line of the arc would include San Diego, Denver, and Milwaukee. Isn't that the geographical situation?

Secretary MCELROY. Your arithmetic is exact, I believe.

Mr. DADDARIO. Just to get the record straight, to follow your testimony, you would say that they have developed in their guided-missile range a missile which has good target capacity and, therefore, if we take this arithmetic, they do have a capacity to hit within this arc that I have described?

Secretary MCELROY. If you take that arithmetic, that is an area in which it is assumed they might place a certain number of their missiles, but it would not be expected they would put 500 missiles in that area.

Mr. DADDARIO. I understand that, but they do have the capacity from there at least to launch missiles which could hit a vital portion of the United States?

Secretary MCELROY. Oh, yes. It is not that they must have 5,500 miles for any attack upon important parts of the United States. It is that they have obtained 5,500 in the opinion of the strategists in order to have a distribution of missiles which would reach the essential targets.

Mr. DADDARIO. Now, Mr. Secretary, I am interested in the Nike-Zeus, and this morning you said that you felt they should not go into production. I am concerned if we are doing everything we should with the scientists in Europe in the research and development features of the Nike-Zeus.

Secretary MCELROY. I think we are, and I would assume that you were given a much more specific answer on that point by Dr. York, because he would have much more specific information to give.

Mr. DADDARIO. From the standpoint of just the overall administrative end of it, who does the research and development for Nike-Zeus—what company? It is Western Electric, isn't it?

Secretary MCELROY. We will answer you in a little bit. This is a fine demonstration by the Secretary of Defense of the fact that he does not influence the placing of contracts.

The CHAIRMAN. Do you want to proceed, Mr. Secretary, while your aide tries to find that?

Secretary McElroy. We can provide this for the record, but this is one of the things I really don't know about.

(The information requested is as follows:)

Western Electric is the company doing the research and devlopment for Nike-Zeus.

Mr. Daddario. This is not so important. The thing that involves me is the system involved.

If we have company X, for example, which is in charge of this research and development for Nike-Zeus, are they being carefully monitored to see how they pass their moneys through to their subcontractors so that research and development in all of the phases of Nike-Zeus are being properly developed?

Secretary McElroy. Well, I can answer you only in general terms to assure you that that is true. But again, Mr. Daddario, the best place to get information on this is from the people who carry it on. I don't know whether you expect to have them up again or not.

Do you expect to have Dr. York?

The Chairman. We presently don't have such plans. We only have our schedule set up through Easter.

Secretary McElroy. I can only assure you that it is monitored and monitored on through the principal contractors themselves.

Mr. Darrario. It is your contention, if we phrase it merely as a formula rather than getting into the specifics, that we should push the research and development phases of Nike-Zeus as completely as possible?

Secretary McElroy. There isn't the slightest doubt about it, Mr. Daddario.

It has No. 1 priority, a national priority, and there are only five or six programs having such priority. The fact that they have the priority means that they will be given absolutely a clear track.

The only question then is whether they are adequately funded, and I don't believe the Army disagrees, and certainly we don't in the Department of Defense have any doubt that the amounts of money assigned to this program for research and development are adequate for research and development on the program.

Mr. Daddario. We are all concerned about that because of the fact that there is no other anti-missile-missile system available to us beyond the Nike-Zeus, as I understand it.

If we don't have proper monitoring, there can be a failure of certain aspects of the Nike-Zeus. For example, the things that come to my mind are the maneuverability functions of the Nike-Zeus, once it gets into the target vicinity. If the enemy sends in a nose cone which has maneuverability of its own, you would have to have the ability to chase after it in order to destroy it.

Are those phases being properly conducted under research and development, or are we taking all of the money and putting it into radar screen development, not leaving enough open?

Secretary McElroy. We are taking all of the uncertain aspects of the program—I don't know whether this will explain it to you, but in addition to the $300 million that has been assigned to the Army for research and development, there is in excess of $100 million in the 1960 budget for Advanced Research Project Agency effort which in-

cludes the kind of thing that you are talking about, with improved techniques for discrimination between the targets, so that you can identify the true target, and various of the highly sophisticated additional kinds of techniques that need to be worked on. So that it is the belief of the project managers of the program that we are working on all of the important gaps in information simultaneously.

Mr. DADDARIO. Could you do this for me, Mr. Secretary: Could you get a list of the companies which are involved in the Nike-Zeus program so that we can then check—not now, but at a later date—check and see whether or not the program is properly being conducted all the way to the bottom from the top, so all of the companies are properly participating in all of the phases, because I would like to see that while we are working on the radar we are also developing the propulsion and maneuverability techniques?

Secretary MCELROY. We will be glad to do that and we will file it for the record.

(The requested information is as follows:)

The following lists show the location and function of the various subcontractors who are working on the NIKE-ZEUS program. The first list, entitled "Major subcontractors", is the list of subcontractors of Bell Telephone Laboratory (BTL), who will spend over $500,000 in the fiscal year of 1959. The second list, "Other subcontractors", is divided into the major areas of the Nike-Zeus program. It includes subcontractors of BTL and its major subcontractors. There are, in addition, many suppliers throughout the country who will supply standard components and hardware.

A. MAJOR SUBCONTRACTORS

Contractor	*Location*
Douglas Aircraft Co	Santa Monica, Calif.
Burns and Roe, Inc	New York, N.Y.
Continental Can Co	Chicago, Ill.
	Coffeyville, Kans.
Goodyear Aircraft Corp	Akron, Ohio
Lear, Inc	Grand Rapids, Mich.
Radio Corporation of American	Moorestown, N.J.
Remington Rand; Univac Division of Sperry Corp.	St. Paul, Minn.
Sperry Gyroscope Co	Great Neck, N.Y.
Western Electric Co	North Carolina Works, Laureldale, Pa.

B. OTHER SUBCONTRACTORS

Burndy Corp	Mount Vernon, N.Y.
Electronics Associates, Inc	Long Branch, N.J.
Reese Engineering	Philadelphia, Pa.
Allis-Chalmers Manufacturing Co	Milwaukee, Wis.
American Machine & Foundry Co	Greenwich, Conn.
F-R Machine Works, Inc	Woodside, N.Y.
Airtron, Inc	Linden, N.J.
Arthur D. Little, Inc	Cambridge, Mass.
Microwave Associates, Inc	Burlington, Mass.
Narmco Manufacturing Co	La Mesa, Calif.
Norden-Ketay	Comack, N.Y.
Vickers, Inc	Detroit, Mich.
Wheeler Laboratories	Great Neck, N.Y.
Precise Metal	Stoneham, Mass.
Consultants & Designers	New York, N.Y.
FAAG	Brooklyn, N.Y.
Western Gear Corp	Lynwood, Calif.
Kaydon Engr. Corp	Muskegon, Mich.
Joseph S. Ward	Caldwell, N.J.
Tulsa Testing Lab	Tulsa, Okla.

B. OTHER SUBCONTRACTORS—continued

Contractor	*Location*
F–R Machine Works	Woodside, N.Y.
Hewlett-Packard Co	Palo Alto, Calif.
Kearfott Company, Inc	Clifton, N.J.
Steel Products Engineering	Springfield, Ohio
Stromberg-Carlson Co	Rochester, N.Y.
Vickers, Inc	Detroit, Mich.
Airborne Instruments Lab	Mineola, N.Y.
Dow Chemical Co	Midland, Mich.
Armstrong Cork Co	Lancaster, Pa.
ITE Circuit Breaker Co	Philadelphia, Pa.
Polarad Electronics Corps	Long Island City, N.Y.
Wheeler Labs	Great Neck, N.Y.
Babcock & Wilson	Milwaukee, Wis.
Plastic Film Co	Akron, Ohio
S. Morgan Smith Co	York, Pa.
Goodyear Tire & Rubber Co	Akron, Ohio
Kaydon Mfg	Muskegon, Mich.
York Research Corp	York, Pa.
Univ. of Minnesota	Minneapolis, Minn.
Adamson United	Akron, Ohio
Wayne Pump Co	Fort Wayne, Ind.
Consultant & Designers, Inc	New York City
Detroit Controls Co	Detroit, Mich.
Dow Chemical Co	Midland, Mich.
Electro-Pulse, Inc	Culver City, Calif.
Litton Industries	San Carlos, Calif.
Ryan Aeronautical Co	San Diego, Calif.
Stromberg-Carlson Co	Rochester, N.Y.
U.S. Time Corp	Waterbury, Conn.
Coors Porcelain Co	Golden, Colo.
Cornell Aeronautical Lab	Buffalo, N.Y.
California Institute of Technology	Pasadena, Calif.
National Research Corp	
Ohio State University Research Foundation	Columbus, Ohio
Stanford Research Institute	Stanford, Calif.
University of California, Los Angeles	Los Angeles, Calif.
Firestone Tire & Rubber Co	Los Angeles, Calif.
Glidden Products	Glendale, Calif.
Era Engineering, Inc	Los Angeles, Calif.
Special Effects Manufacturing Co	Los Angeles, Calif.
Batelle Memorial Institute	Columbus, Ohio
Grand Central Rocket Co	Redlands, Calif.
Thickol Chemical	Huntsville, Ala.
AiResearch Co	Los Angeles, Calif.
Pacific Alloy Engineer Co	Los Angeles, Calif.
American Brake Shoe Co	New York, N.Y.
Barden Corp	Danbury, Conn.
Pratt & Whitney	Hartford, Conn.
Paul Hance Productions, Inc	New York, N.Y.
New Mexico A. & M	Las Cruces, N. Mex.
Sanders Associates, Inc	Nashua, N.H.
W. F. Turney and Associates	Santa Fe, N. Mex.
Dames & More	New York, N.Y.
Stavid Engineering Inc	Plainfield, N.J.

Secretary McElroy. I would suggest, Mr. Daddario, if you would like to do it, that we ask one of the people who carries the immediate responsibility in this area to come up sometime at your convenience and discuss this with you, so that you not only have the list but also have it from him directly, just what is done.

Mr. Daddario. One last question, Mr. Secretary.

Are you satisfied that in the field of production research concerning the Nike-Zeus program, we are doing enough, so in the event we do

develop a system, that we are then able to produce it with the highest efficiency, with the least cost and in the shortest period of time?

Secretary McElroy. This is the kind of thing, again, which I referred to this morning. It is production planning which is under study, and the objective of that preproduction planning is to do exactly the sort of thing that you are talking about.

I don't think we are ready to do what you have requested, at this stage, but we should be ready to do so in plenty of time so that we lose no time or a minimum amount of time in getting from the design stage to the production.

Mr. Daddario. And this is one of you objectives?

Secretary McElroy. Yes, sir.

The Chairman. Mr. Moeller.

Mr. Moeller. Mr. Chairman, I will be very brief.

You have very skillfully handled yourself here in the presence of some very skilled interrogators, so I will not ask you many questions.

One thing concerns me very much, and I wish you would make a statement on it. I think there is entirely too much talk in open meetings, even as we have here this morning or this afternoon, about things that are of such prime importance for our security.

Would you not feel that there ought be a ruling that any information released by our committee on the security program—I am thinking, for example, of an article which appeared in one of the papers yesterday, talking about our missile program and just exactly how we will place these various missiles X miles apart, et cetera.

I am sure that information must be on the way already to the Kremlin. If that kind of thing could be prevented, we could advance ourselves materially in our own defense program, do you agree?

Secretary McElroy. I think that we go much too far in telling our opponent how we are giving priority to different kinds of programs.

I would like to say, however, sir, that there is one thing to be said about letting our opponent know of certain of our strengths. I am not in favor of letting him know to the extent that we do, what may be our weaknesses. If we let him know what our strengths are, then it becomes of some importance as a deterrent to him through miscalculations. But if we talk a great deal about our weaknesses then it seems to me we may encourage an adventure by him because he believes in what we say are our weaknesses. This is a kind of a tendency of us in this country which in his kind of society, he would find difficult to understand.

Mr. Moeller. It would certainly remove a lot of confusion in the minds of our people.

Secretary McElroy. It would indeed.

Mr. Moeller. You have indicated, and others too who have appeared here, that the whole world is in a position today to literally destroy itself. A world holocaust without question is facing us unless something can be done about it.

I know this is not in your defense domain, but would it not seem reasonable that we ought to explore more of the area where we could sit down with the enemy and reckon on this situation, before we destroy ourselves? In other words, possibly we could start a disarmament race to save civilization.

Secretary McElroy. Certainly if there were any means by which you could have a respectable disarmament program it would be something devoutly to be desired. The problem as we all know is that we are dealing with an opponent who feels no responsibility to make good on commitments made.

This country on the other hand feels an absolute obligation to make good on commitments. It is therefore very difficult to work out any kind of a deal between people who feel as they do and as we do, on the same matter.

Surely you are aware of this problem.

The Chairman. Mr. Roush——

Mr. Roush. I have one comment on one question. My comment concerns Mr. Fulton's statement this morning that possibly we could devise a way of deflecting these missiles. I do not believe he was being facetious. I do not believe he was and my comment is that I am convinced that anything that man can imagine in the field of science these days, America can accomplish. I really believe that. I further believe that is the attitude we are going to have to take if we are to stay ahead.

My question is a rather simple one. Other than in the field of scientific research and theorizing, have the other nations of the world contributed anything to this missile program? That is the free nations of the world? Have they contributed anything to the defense of the free nations of the world by way of missiles?

Secretary McElroy. I am not in a position to give you a specific answer to that. However, I would be prepared to believe that the contribution, particularly by British scientists in the field of radar, have been so significant that it would hardly be possible for us to be moving up in the missile field as we are without drawing on much of the scientific contribution of the British in this area.

Would you agree with that, General Twining?

General Twining. Yes.

Secretary McElroy. This would also be true, General Twining points out, about the French.

Mr. Roush. We are assuming the burden in the field of missiles, satellites and whatever, is that correct?

Secretary McElroy. The bulk of it is being done from here, that is correct. This is partly due to the fact that the long range missiles are needed only by this country. The long range missile requires somewhat more in the field of thrust, sophistication, guidance and the various things than the shorter range missile, so I think it is true that part of the reason we are doing somewhat more in this area is that our need is greater.

Mr. Roush. Thank you, sir.

I have no further questions.

The Chairman. Mr. Secretary, I have been asked to ask you one or two questions. I know the hour is getting late and you have been most patient. You have been an excellent witness and it indicates your prior experience and ability in managing a great industrial concern that you are able to put those same talents to work here in the Defense Department.

My colleague, Mr. Teague, suggested—and I think his suggestion is an excellent one—that I ask you if you would elaborate for the record

how important you think the space program as a whole is to the national defense in the next 10 years in the course of development.

Secretary McElroy. Well, there is much that I would not know about how this would develop in any such a long period, Mr. Chairman. There are certain aspects of outer space which are important today for defense. We would like very much to have these available to us right now.

There are others where you have to do a certain amount of guessing. I do think that the potentialities of outer space for defense are sufficiently great that we cannot fail to search these out, prove them out through a subsantial program of experimentation and I am sure that is what the budget program for 1960 is intended to do.

Now some of these military programs are urgent and we are treating them that way in their financing and in the way in which we are pursuing them through the Advanced Research Projects Agency.

Now further down the road I find it very difficult to speculate because I think the guide posts are too few. I think anybody who would estimate as to the way we would be looking at space and the military uses of space 10 years from now would be somebody who would have more temerity than I would have, sir.

The Chairman. In the course of these hearings, someone used the word "aero-space" indicating when you leave terra firma and you go into air and space. Is the development of space akin to the development of the air and would you say similar developments and achievements in space would be equally—certainly as as important as the prior developments in the course of air?

Secretary McElroy. I would be prepared to believe that the developments in space would be far more significant because of the tremendous reaches of space.

I am not completely clear in my thinking, and neither are some of the more profound thinkers than I, in this area as to just what the military uses of space are going to be beyond those that we specifically see right now. At the same time, I have come to believe, simply because this seems to be the way progress in new fields of scientific exploration have gone over the years and centuries, that there will be additional new military uses for outer space and they will be in my opinion quite significant. Now exactly what they will be, somebody else will have to guess.

The Chairman. You would say right now that the use of missiles, guided missiles, and intercontinental ballistic missiles is extremely important to the defense; would you not? You would include the use of satellites for communications, the use of reconnaissance satellites, the use of weather satellites, and all of those things which have direct and immediate importance to the defense—in fact, they are the fiber of this country—in this group; would you not?

Secretary McElroy. Yes, sir.

The Chairman. I do not put that too strongly; do I?

Secretary McElroy. No; you do not. I agree with just what you have said.

Mr. Teague. I would like to ask General Twining if he expects to ride in a manned satellite.

General Twining. I hope to, but I doubt it.

The Chairman. He is a brave enough man. If it was necessary he would do it.

I have a couple more questions. We read in the morning paper that ARPA is embarking on a new and radical approach to the anti-missile-missile program.

These were suggested as an alternative to the Nike-Zeus program. The studies involve antigravity, antimatter, and death rays. Can you tell us about any of these proposals? They are not intended, are they, to camouflage the Nike-Zeus program?

General TWINING. Absolutely not. We are proceeding with Nike-Zeus in absolute top priority.

They do get into advanced thinking on projects assigned to them and one of those is the defense against missiles.

To be perfectly honest with you, I do not even know what some of those things are myself.

The CHAIRMAN. Well, we read it in the paper, and of course it is all right to mention it here.

Secretary MCELROY. Oh, yes. I am not complaining about it being mentioned. I am only saying that there are quite a lot of things going on in the Department which I confess the Secretary doesn't know about in any detail.

The CHAIRMAN. I would like to add to that another question, which is about the same, with reference to the Wizard system of antimissile operation.

Perhaps General Twining might say something. We get that out of the press, too.

Secretary MCELROY. The Wizard system is one that was being developed in parallel to the Nike-Zeus system by the Air Force, and something over a year ago, we asked that the work on that be discontinued.

The CHAIRMAN. So that is out?

Secretary MCELROY. Yes, sir.

Mr. FULTON. January 1958.

General TWINING. I think the committee must realize that the services all have programs of their own, and they are working on them. They have not been put up to the Secretary of Defense's Office as yet, and these sometimes leak out through channels, and you hear about those. That will happen all the time. There is nothing wrong with that, but those things you must realize are not approved projects in any sense of the word. It is a service idea, and it may be a good one, and it may be approved later, but most of them aren't approved yet. Those are floating around in trade magazines, and you will see them everywhere. That is another one of the confusing things. They aren't approved projects yet. They may be.

The CHAIRMAN. In other words, we are getting down to the grassroots, now.

General TWINING. That is right.

The CHAIRMAN. Mr. Fulton wanted to ask you one more question, Mr. Secretary.

Mr. FULTON. I hope that you will consider the so-called missile booster program, to give them a push or a shove instead of trying to destroy them or knock them down the way we have been talking about earlier. I think you should look into it.

Secretary MCELROY. It is an interesting concept. And as was previously said here by Mr. Roush, there is no use any more saying

what can't be done. We have seen too many things that can't be done, done in our own lifetimes.

Mr. FULTON. And if you have been working on an ion engine which in outer space is to be propelled simply by the impact of ions on space, by submission from some sort of an sparking arrangement, we might by some sort of an arrangement induce ion emission or heat radiation at the rear of a missile when it is in outer space, where a very small amount of it would give it a totally different terminal point and a totally different trajectory, so I hope that you will consider that. While we are in the new idea department, may we have one more:

We are also talking about orbiting around the earth. Satellites continuing—and the amount rises from kilotons to megatons—hundreds of thousands of tons of TNT, and goes up to many megatons—millions and millions of tons of TNT.

Why is it when we have a heaven-made satellite, the moon, don't we plan on orbiting such deadly things around the moon. And if we are able to orbit them around the moon, we keep them as sort of a missile barn and then if Russia goes to hit us, by command decisions, which we know we can give now 78,000 miles out, we merely bring in the missiles?

We don't have them over this world of ours, and in this country, and we have them in the air all the time. And if they start something, then we are all ready to give them a crack from a base where we will know if they are going to try to get at us out there. Why don't we do that?

I put that to the general.

General TWINING. I would like to see them develop a missile that can hit a target, first, but your ideas are certainly good, but they are a way, way out in the future. They certainly have possibilities.

Mr. FULTON. It would give us a separate base where we would have 2 days' advanced warning. Where now we are talking merely about warnings that are 10 minutes, 15 minutes, or an hour, to evacuate a whole city of a million or 10 million people.

General TWINING. We have been talking about this satellite for many years that is parked up there ready to launch against an enemy.

Mr. FULTON. Don't tell me you have been talking about that sort of thing.

General TWINING. It is a long time off. We have to work on those things, I agree.

Mr. FULTON. Have you been considering using the moon as a missile park, or a missile range, where you just keep orbiting the missiles around?

General TWINING. That is right. We have talked about this for some time. And the Army will have troops up there floating around, too, and we can drop those.

Mr. FULTON. The Air Force will have the missiles going around the moon, not the Army.

General TWINING. Yes, sir.

The CHAIRMAN. One more question, Mr. Secretary, and this may be just a little off the subject that we have been discussing today—space—but it is on the ground anyway. This in my judgment is a very critical period of time through which we are passing.

The British now repealed their draft act and we, on the other hand, are cutting down the size and strength of the Army. What effect is that going to have on the Russian mind, if you wish to answer that at this time?

Secretary McElroy. I think the real influence on the Russian mind depends on his belief that this country would respond to an aggressive attack with a force that would destroy his country.

The Russian ground forces have been and probably always will be so much in excess of our own that when you reduce our ground forces 3 percent, which is what we have done in going from 900,000 down to 870,000, I don't think this is going to have a particular influence one way or the other on the Russian.

What we have to do is to maintain our ability to make a shambles out of the country if he takes a crack at us.

The Chairman. Are there any further questions?

(No response.)

The Chairman. If not, Mr. Secretary, and General Twining, you have been very patient and again I want to thank you on behalf of this committee. I think personally you are doing an excellent job with the Secretary down there in the Defense Department. Of course, I have known General Twining for many years, and I don't think you could have gotten a better man as Chairman of the Joint Chiefs of Staff had you even forgotten the national boundaries and looked abroad in any other country.

Secretary McElroy. Wonderful.

Mr. Fulton. May I join with the chairman in both of these statements.

We are glad to have you, and I think you are both doing a fine job.

Secretary McElroy. I would like to thank your committee on behalf of both General Twining and myself for a very courteous interrogation.

The Chairman. We have been happy to have you.

If there is nothing further, we will adjourn until tomorrow morning at 10 o'clock.

(Whereupon, at 4:25 p.m., the committee was recessed, to reconvene at 10 a.m., Tuesday, March 3, 1959, on another subject.)

MISSILE DEVELOPMENT AND SPACE SCIENCES

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., Thursday, March 12, 1959.

The committee met at 10 a.m., in room B214, New House Office Building, Hon. Overton Brooks, chairman, presiding.

(The committee considered problems related to another subject until 11:30, after which it resumed the general topic, "Relating to Missile Development and Space Sciences.")

The CHAIRMAN. This morning we have another witness I think we ought to hear, since he has come down here ,and that is Dr. J. Allen Hynek. I might say that members of the committee have requested the appearance of Dr. Hynek, who is Associate Director of the Smithsonian Astrophysical Observatory of Cambridge, Mass.

Doctor, if you will have a seat, we would appreciate it.

Dr. HYNEK. May I ask, Mr. Chairman, whether I could ask Mr. Leon Campbell, who is in charge of the moon watch program, to sit with me?

The CHAIRMAN. Yes, sir, Mr. Campbell, if you would come forward. Anybody else you want up with you, we will be glad to have them.

Dr. HYNEK. Thank you.

The CHAIRMAN. I might say this: This observatory, of which Dr. Hynek is Associate Director, has served as headquarters and nerve center for the optical tracking operations used successfully on several Soviet and American satellites. For that reason, we are especially interested in what you gentlemen will tell us this morning.

Do you have a prepared statement, sir?

Dr. HYNEK. Mr. Chairman, I do not have a prepared statement. As I indicated to Dr. Sheldon, I would be happy to try to answer some questions. I would like, however, to tell you something about the optical tracking program.

The CHAIRMAN. I wish you would do that for the benefit of the committee. Then, also, if you prefer, of course we will ask you in reference to your suggestions regarding failure to alert your observatory.

If you want to make a statement on that, we will be glad to have that. If not, we will question you.

STATEMENT OF DR. J. ALLEN HYNEK, ASSOCIATE DIRECTOR, SMITHSONIAN ASTROPHYSICAL OBERVATORY, CAMBRIDGE, MASS.

Dr. HYNEK. The Smithsonian Astrophysical Observatory, which is located in Cambridge, Mass., was during the IGY given the responsibility of the optical tracking of earth satellites. Optical tracking differs from radio tracking and other means of tracking in that optical instruments are used in the line of the traditional astronomical methods. Because, as far as the astronomers are concerned—and I am speaking now as an astronomer—satellites in general are an astronomical problem.

So that there was designed at the Observatory a special satellite tracking camera, the so-called Baker-Nunn cameras. I have some pictures here. This is one. This is the picture of the camera itself, and I have some photographs here of satellites taken with the camera, which you may wish to see later or may not.

The stations are located in 12 places around the world. I have one picture there, the top one, which I am particularly proud of, and that is the photograph of the Vanguard 6-inch sphere at a distance of essentially a thousand miles, 945 miles, I believe it was.

The stations are located in a belt about plus 40 to minus 40 latitude.

Very, very quickly from memory, the stations are in Hawaii, two in the United States, three in South America, one in India, one in Iran, one in Australia, and one in Japan.

In addition to this precision optical tracking, the instruments are capable of fixing—stopping the satellite in its track, so to speak—down to the accuracy of 1 second of arc. This is the angle subtended by a penny at a little more than 2 miles. This precision is needed in order that satellites be more useful as scientific vehicles. I would like to go into that a little more later also.

In addition to the precision optical tracking program, we have some 240 volunteer teams of so-called moon watch observers. This is an accuracy of a total difference of the order of about one-thousandth of the accuracy of the precision of the Baker-Nunn cameras. But the larger number gives, of course, much wider coverage. We have some 140 such teams in the United States, a great many in Japan, and many scattered in other countries.

In addition, then, if you have these stations, of course, around the world, this implies a rather efficient communications network, and it does also mean the existence and the fostering of a computation center, since merely to observe for the sake of observing without using those observations would be pointless.

I think this perhaps is sufficient. I might point out that we have obtained hundreds of photographs of the various satellites. There have been something like 8,700 observations, moon watch observations, from volunteer teams. I would like to point out there that in the volunteer teams, we did not pay at all for their time nor for the equipment that most of these people have built or purchased themselves.

I believe with that introduction, I am ready for any questions.

The CHAIRMAN. Doctor, would you object to giving us something of your background now? I read, insofar as I had information from an article in the paper. Tell us about where were you born, where

you were educated, and your background and experience for the record.

Dr. HYNEK. I shall be happy to. I was born in Chicago in 1910, and obtained both my bachelor's and doctor's degrees at the University of Chicago. Then I was, and still am, for many years a professor of astronomy at Ohio State University. I am actually at present on leave from the Ohio State University, working in the capacity as Associate Director of the Smithsonian Observatory and directly in charge of the optical satellite tracking.

The CHAIRMAN. How long have you been there?

Dr. HYNEK. I have been at Smithsonian now for some 3 years.

The CHAIRMAN I read something in the press in reference to your statement indicating you had not been notified of the recent launching of a satellite. You felt that perhaps, if you had been notified, your service might have been helpful in locating that.

Could you tell us something about that?

Dr. HYNEK. Yes; I should be happy to tell you the circumstances of that, because I believe there is a certain area of misunderstanding surrounding that.

A reporter called up to ask whether we had been tracking the Discoverer and I said in direct answer to the question, I said, no, we had not been. He, of course, wished to know whether we had alerted our stations and I mentioned that we had not.

He naturally asked why not, whereupon I pointed out that we had received no official information or request to do so.

He then immediately went on to ask whether, had we been so notified, could we have tracked it? At that point my answer was solely directed to the capabilities of our system for tracking, and I pointed out that in view of the fact that we had photographed many, many satellites, in particular the 6-inch sphere, that as far as the capabilities of the system were concerned, we certainly could have tracked it.

However, it is certainly well known, and I was fully aware of this, that the visibility of the satellite is, of course, a function of the size and shape of the orbit, of its inclination to the equator, and particular in the case of a high inclination orbit, to the time of launching. At the particular time this object was launched, it was not in the general visibility zones of our stations.

Had the launching taken place, however, some 3 hours later, it would have been visible to all of our stations. It is an extremely critical thing. But I wish to emphasize for the record that when I pointed out that we could have tracked it, I was referring solely to the capabilities of the system.

The CHAIRMAN. What was the reason for launching it 3 hours earlier than you were able to detect it from your station?

Dr. HYNEK. This, sir, I don't know. This project, I believe was militarily classified. We had no advance information on either why it was being put up or otherwise. However, it may very well be that they had specific reasons for launching it at that time, and hence felt that there was no point to alerting us.

The CHAIRMAN. You stated, I believe, that rivalry among the U.S. space programs was blamed for failure to be alerted. Is that correct?

Mr. HYNEK. No, sir; it is not. I believe I have with me the actual statement. I felt I was particularly careful to stay away from state-

ments over which I have, first of all, no competence to discuss. My job is——

Mr. FULTON. Do you have the original statement you gave out with you?

Dr. HYNEK. I do not, sir. About a week later I made some notes to the best of my recollection. But after I answered those specific questions, I was conscious of a rather strong desire to hang up and get off the hook——

The CHAIRMAN. Most of us know what you mean there, Doctor.

Dr. HYNEK. I had to answer those questions or hang up, and it just isn't courteous to just hang up. But I felt that once I had answered those specific questions, that anything further I went on to say, could very easily be misinterpreted.

I do believe that—I am quite certain that I at not time stated matters of rivalry or lack of cooperation, because as far as cooperation is concerned, we have had a tremendous amount of cooperation from the various services.

Mr. FULTON. Was this an unintentionual mistake as distinguished from a better method of doing it, rather than an intentional mistake, which may have been read into your words?

Dr. HYNEK. Sir, intentional on whose part?

Mr. FULTON. On the part of the scheduling officers on the shot as to the time of launching, where on a 3-hour difference they could have picked it up on a worldwide tracking system that you have set up for precision optical tracking, it would seem to me either somebody made a mistake, or somebody intentionally didn't do it at the right time. So which is correct?

Dr. HYNEK. I would have no way of knowing that, sir.

The CHAIRMAN. Doctor, in the light of what happened there with the Discoverer shot, could you say that your stations, had they been alerted, might have been of help in tracking that satellite?

Dr. HYNEK. I could certainly say that had the launching been at a different time, say 3 hours later, I believe certainly that we could have been of help, as we have been in many other launchings.

The CHAIRMAN. Your statement that you could have been of help is conditioned on the fact that it should have been launched 3 hours later.

Dr. HYNEK. That is correct, sir.

The CHAIRMAN. Launching as it was, you could not have been of any assistance, is that right?

Dr. HYNEK. That is correct. I was mentioning, when I indicated rather hurriedly to the reporter that we could have tracked it, I was speaking solely of the capabilities of the camera and of the moon watch teams to have tracked it.

Mr. FULTON. Actually the first time you heard about this satellite was when you either heard it on the radio or read it in the newspapers, wasn't it, as to the time it was launched?

Dr. HYNEK. That is correct.

The CHAIRMAN. Didn't that give you enough notice even then because it came over your area on, as I recall it, the third orbit?

Dr. HYNEK. I think perhaps I should say here that because of a polar launching—let me start this way—optical tracking as opposed to radio tracking, is at least until such time as satellites have flashing

lights on them, visible only in the morning and evening twilight periods, like a high-flying jet.

Consequently, any satellite will, on the average, come over any one geographical area twice a day, but only if that time coincides with the morning or evening twilight can one observe it optically.

The CHAIRMAN. Didn't it come over your area at twilight?

Dr. HYNEK. Not at twilight; no, sir. In fact at no place at twilight. At that launching time, the twilight zones—I have a chart here if we need to go into it later—but the twilight zones were quite far to the north and to the south.

The CHAIRMAN. So even had you been notified, unless the time for launching had been changed, you could not have been of any assistance?

Dr. HYNEK. That is entirely correct.

The CHAIRMAN. Your colleague who is sitting with you there, are you in charge of the moon watch program?

Mr. CAMPBELL. I am, sir.

The CHAIRMAN. What would be your statement in reference to that? Do you make the same statement that your program would not have been of any assistance unless the time of launching would have been different?

Mr. CAMPBELL. I concur with Dr. Hynek's statements on that. I have not looked into the visibility zones.

Mr. FULTON. Were you consulted as to the time of launch so that you could be given the chance to have your tracking facilities operate for this precision optical tracking?

Were you contacted ahead of time?

Dr. HYNEK. In this particular instance we were not. However, I think it is appropriate to say that in a great many other instances, we have been.

Mr. FULTON. Why weren't you in this instance? We are trying to develop what is wrong with the procedure that one of our chief Government agencies in astronomy does not know of a shot going up in a way that their own program can be correlated with it. You see, obviously it wasn't the best scientific approach to the shot because you could have added a lot; could you not?

Dr. HYNEK. Predicated on a different launching time, perhaps so; yes.

Mr. FULTON. Did they consult with you as to the optimum launching times in order to get the best use of the facilities? We are interested in this not only with you people, but to correct it with our allied countries in the free world and also the Soviet Union, if they will assist.

Why were you left out of the consultation?

Dr. HYNEK. The direct answer to your first question is that we were not consulted on the best launching time.

Mr. FULTON. Should you have been?

Dr. HYNEK. That is very difficult for me to answer since I don't know what the nature of the experiment was in this particular satellite. It may be that they just had to launch it at that particular time, and they felt, therefore, that there was no point in notifying us in advance.

The CHAIRMAN. Their statement was, of course, that you were not notified because you could not have rendered any assistance with that launching time. And your statement confirms that.

Dr. HYNEK. That is entirely correct; yes.

Mr. FULTON. The problem was, was the correct decision made as to the correct launching time when it left the Smithsonian facilities, the precision optical tracking, out, which is a great scientific gain.

If so, wouldn't it be more careful to check with you each time to find whether you could be of assistance on a change of launching time?

Dr. HYNEK. I would like to answer that in this way, if I may. Just yesterday we were visited by an agency concerned with the coming Venus probes. I obtained permission to be permitted to say this——

Mr. FULTON. From whom?

Dr. HYNEK. From the Space Technology Laboratories.

The CHAIRMAN. You don't need that, do you?

Dr. HYNEK. You are quite right. I don't need permission, but I thought it was a matter of courtesy I should ask.

The CHAIRMAN. You are a man who speaks out fearlessly anyway, judging by this article. So I think we all understand that.

Mr. FULTON. He is, or he was? He sounds as if he has sort of reefed his sail a little bit.

Dr. HYNEK. Gentlemen, this is my very first experience in a meeting of this sort, and I am naturally a little timid—not intimidated, just a little timid.

Mr. FULTON. This is a higher orbit than you had been expecting?

Dr. HYNEK. This is a higher orbit; yes, sir.

The CHAIRMAN. Why not do this, Doctor, since you are here, give us a general idea of your work there, and then the members want to ask you a few questions.

Mr. KING. He was about to make a statement on the Venus probe. I want to hear it.

The CHAIRMAN. Go right ahead with your Venus probe.

Dr. HYNEK. The Agency is quite anxious that we do everything we can to obtain optical observations of this, and we are consulting as to the best launching times, the best methods of communicating between us, and so forth.

Mr. FULTON. Would you recommend that in the future your group be consulted as to the optimum launching times so that we can get the proper precision optical tracking that seems to be necessary?

Dr. HYNEK. Insofar as we can be of any service, I would say so, yes.

Mr. FULTON. Then it was a mistake when they didn't check with you, isn't it, because they just assumed you wouldn't be able to help, and they didn't know what 3 hours difference would have made to you, did they?

Dr. HYNEK. They, I believe, assumed that in this instance we couldn't have helped, yes.

Mr. FULTON. That is all.

The CHAIRMAN. Mr. King, do you have questions?

Mr. KING. No.

Mr. WOLF. Mr. Chairman, might I ask a question at this point of you, sir?

The CHAIRMAN. I think I recognized Mr. Moeller.

Mr. MOELLER. I will yield.

The CHAIRMAN. All right.

Mr. WOLF. I am wondering if anyone has inquired—he says that he doesn't know—Dr. Hynek says he doesn't know the reason. Has

anyone from this committee inquired, or do we intend to have someone here to possibly tell us in executive session why this thing was done in this manner?

The CHAIRMAN. We asked in open session the witnesses why these particular stations were not alerted. I called attention to the statement of which I have a copy which appeared in the New York Times. At that time the committee was informed that the reason they were not notified was the satellite was not coming within the sphere of their activity, and therefore they could not have rendered any service.

That was the answer.

But in the light of the request from members of the committee, we thought we would ask the doctor to come down here. If you wish to, we can go further into the matter.

Mr. WOLF. We had better.

The CHAIRMAN. Have you finished interrogating the witness?

Mr. WOLF. I think I said we had better go further into it. There seems to be a wide difference of opinion here now.

Mr. MOELLER. Mr. Chairman, this seems to tie in with some of the testimony we received, which indicated that the information to be desired from this particular satellite was gathered without this assistance, is that correct?

The CHAIRMAN. I can't tell you whether it is correct or not.

Mr. MOELLER. That is an assumption I operated under.

The CHAIRMAN. I have not made up my mind definitely on the matter, except as to this: If the good doctor's facilities can help in this program, he certainly ought to be alerted and be permitted to assist.

Mr. FULTON. May I suggest to Mr. Moeller, he ask the doctor the question directly.

Mr. MOELLER. You heard the question, Doctor. I think you alluded to it also, Doctor, that possibly the information they received on this particular instance, they got without your assistance.

Dr. HYNEK. That is entirely possible.

Mr. FULTON. But you don't know it?

Dr. HYNEK. I don't know it.

Mr. FULTON. Why don't you know it? This is your field. Why are you not alerted on these things, because in the future some of us want you to be alerted and be part of this.

Dr. HYNEK. If I may speak to that point, and dropping the specific instance for a moment, as we prepare to put man into space, clearly we should use every possible tracking means we have, not just optical, radio, but every possible means to see that he gets back safely.

Under those circumstances I would heartily concur and agree that there should be full coordination.

However, it is entirely possible if an agency has an experiment, a very particular experiment for perhaps classified military purposes, then they might feel that it is not wise.

The CHAIRMAN. Mr. Anfuso?

Mr. ANFUSO. That is exactly what I wanted to bring out, Doctor. We all appreciate what you are doing. You are doing a very fine job.

I think in this particular case this was supposed to be a military project. They may have had a special reason for not notifying you. I am glad to hear you say that you accept that.

Dr. HYNEK. Yes, I do.

Mr. ANFUSO. Under certain circumstances you don't care to be notified?

The CHAIRMAN. If he can be of assistance, he should be notified.

Mr. ANFUSO. If you can be of assistance, certainly if you are notified you will be glad to give all your cooperation, as you have in the past.

Dr. HYNEK. Entirely.

Mr. FULTON. Will my friend from New York yield?

Mr. ANFUSO. Yes.

Mr. FULTON. Don't you think he should be given the opportunity on his own agency to determine whether he feels that his group can be of assistance with his own technical assistants by prior consultation to the time of launch to help set the time of launch so that all facilities will be used?

Don't you think that should be done?

Mr. ANFUSO. I concur in that. But, as I said, I think they had a special reason for what they did. I don't think you can inquire from Dr. Hynek as to that special reason because he certainly doesn't know.

Mr. FULTON. What does the doctor think, in answer to my question? Don't you think that should be done?

Dr. HYNEK. If it turns out that we can be of help; yes, I do think it should be done.

Mr. FULTON. So you feel you should have been consulted on this one because just a 3-hour change in the launch would have given you full use of your facilities and you might have picked something else up extra.

Dr. HYNEK. That is certainly within the range of possibilities, yes; we could have. But again——

Mr. FULTON. He is a brave man right now.

Mr. ANFUSO. Do you feel any slight that you were not notified?

Dr. HYNEK. No, sir, in view of the fact I feel that we may not have been notified because there were extremely good military reasons for not having been notified.

Mr. ANFUSO. And you accept those reasons?

Dr. HYNEK. Yes, I do.

Mr. ANFUSO. Can you give us any information on trying to track Mechta?

Dr. HYNEK. That is so far out now that tracking would be quite impossible.

Mr. ANFUSO. Do your observations tell you how large the Soviet sputniks are?

Dr. HYNEK. They can give us quite a good indication. For instance, in the matter of the weight of the sputniks, simply in this manner. One can see how bright they are; one knows how the period changes. The rate of period change is a function of the mass-surface area ratio.

Since we can get the surface area by the brightness, we know how the period changes. We can, therefore, arrive at the mass.

Mr. ANFUSO. Have you arrived at any conclusions as to the size of the Soviet sputniks?

Dr. HYNEK. Yes, of the total weight. The total weight, I believe, was something of the order of 3 tons, the second sputnik.

The CHAIRMAN. Will the gentleman yield? What do you mean by period changes there?

Dr. HYNEK. The time that it takes the satellite to go around the earth once is the period; and if the earth had no atmosphere, then a satellite—any satellite—would stay up forever unless it suffered collision.

But because most satellites so far have been operating in the area of very rarefired atmosphere—still, I believe, several million molecules per cubic inch—this constitutes a frictional force. The energy of the satellite is sapped away, and it must then spiral down.

The rate at which it changes its motion gives us then the information on the friction, and the friction is dependent on both the mass and the surface area that it presents to the atmosphere.

The CHAIRMAN. The size, rather than the weight so much?

Dr. HYNEK. Correct. It is the ratio of the two.

Mr. ANFUSO. I am finished.

The CHAIRMAN. Mr. Daddario.

Mr. DADDARIO. Doctor, if we are to assume that there were some military reason why you were not informed, has there been any time since the launching of the Discoverer when it would have fallen between the zone wherein you have your observatory facilities and your moon watch stations?

Dr. HYNEK. I haven't looked into this in detail, but by and large I believe not, simply because, launched directly as a polar orbit, the regression of the nose—that is, the rate at which the orbit skews around—is zero.

It increases as the inclination approaches the Equator. Consequently, the only thing that would bring the orbit into twilight zones in, say, around the Equator, is the earth's own orbital motion around the sun, which would take some 3 months before this brings it around to that.

The same 3 months' effect could have been accomplished by a 3-hour difference in launching. But this is the difference.

Mr. DADDARIO. You say you believe not, and you have given an explanation. Is that all on what you believe to be the situation, or have you since the launching been given specific information so that you have been able to determine that with the specific figures in mind?

Dr. HYNEK. We received the official notification on the launching of Discoverer giving the orbital elements some 8½ hours or so after the launching. It actually arrived in our office at 1 a.m. or so on Sunday morning.

Then, using those figures, it is possible—although I have not done it personally—to deduce where it would be visible.

Mr. DADDARIO. I didn't get the last part?

Dr. HYNEK. It would be possible to deduce, to compute, over which stations it would be visible.

Mr. DADDARIO. Have you been able to compute that and have you so determined that it would not at any time go over any of the stations which belong in your system?

Dr. HYNEK. I think I can quite safely say it would not go over any of the major stations. It might go over some of the far northern moon watch stations.

Mr. DADDARIO. Then, if we are to take all of this into consideration—and the reason I am interested in this is because there is so much confusion—we can determine, can we not, that the Department of Defense and NASA and all of these operations actually do cooperate with you; and in this particular case, because of the fact that it would not have been likely that the satellite Discoverer would have fallen anywhere within the purview of your stations, that that was the reason you were not informed and the only reason, because in this case you could not really have added any material value to the experiment?

Dr. HYNEK. Predicated on that launching time, I would agree completely, sir.

Mr. WOLF. Will the gentleman yield?

The CHAIRMAN. Mr. Wolf.

Mr. WOLF. I was just wondering, Doctor, can you track optically without first being given some orbital information obtained from electronic tracking? In other words, the moon watch teams might not have been able to discover Discoverer.

Dr. HYNEK. If we know in advance the anticipated launching conditions, then we can, with a high degree of probability, tell the moon watch stations where and when to watch.

If the actual orbit turns out to be in the same ballpark with the anticipated orbit, then even the Baker-Nunn stations we can have send advance predictions based on an anticipated orbit.

The CHAIRMAN. Doctor, since you are down here now, will you give the committee a general idea of your work very briefly because the hour is getting a little late. Could you make any recommendations as to your work?

Dr. HYNEK. The work, as I mentioned, is optical tracking. Optical tracking has the primary benefit in that it is the most precise method of tracking. It has the disadvantage that at least at present it is usable only during the twilight periods. This will be changed when satellites are placed in orbit that have flashing lights on them, or infrared techniques are developed to detect them during the daytime; and work is going on on that also.

The CHAIRMAN. How far out would you be able to observe a light on a satellite?

Dr. HYNEK. This would be just entirely a function of how much power, how many batteries, the thing could carry; how powerful the light could be. Work is now going on to see whether a monochromatic flash lasting just a few thousandths of a second, but extremely powerful and therefore using power for just a short interval, would not be the way of solving that problem. It may very well be.

The CHAIRMAN. How far out were you thinking, did you have in mind that you might observe that?

Mr. FULTON. And wouldn't it depend on the point where the satellite is, whether it is in the earth's shadow or in the sun?

Dr. HYNEK. It would. The optical program so far has been designed primarily for earth satellites that are reasonably close to the earth. The present optical tracking program, until either the light gets considerably brighter or the objects themselves get much larger, would not be very good for distant spaceships or distant probes.

The CHAIRMAN. This shot which bypassed the moon: You would not have observed it even with the light that far off, would you?

Dr. HYNEK. You are quite right, sir—not that far out. However close to the earth on its way out, if accurate observations are obtained of that, then the total orbit can be computed with much greater accuracy than otherwise.

Mr. FULTON. Actually, we don't have any kind of candlepower available that would give you a light of any kind from the distance of the moon. It is the candlepower of probably a thousandth power.

Dr. HYNEK. Yes, that is quite right. I have here some figures.

Mr. FULTON. What is it—16 to the 10th power? Sixteen times ten to the tenth?

The CHAIRMAN. What do you say, Doctor?

Dr. HYNEK. I have simply some calculations as to the size versus distance. I am just assuming reflected sunlight. For instance, a thousand-foot sphere at the distance of the moon would appear as a seventh-magnitude star. That is, a star that is just a little fainter than can be seen with the unaided eye.

But this is a thousand-foot surface.

Mr. QUIGLEY. Diameter?

Dr. HYNEK. A thousand feet in diameter; yes, sir.

The CHAIRMAN. What about your ability to use instruments other than visual tracking in your stations? Do you have any such ability?

Dr. HYNEK. We are at the present very carefully looking into electronic types of tracking other than radio—that is, popularly television techniques. The television-type camera is far more sensitive. They say it has a quantum efficiency of better than a hundred times that of the photographic plate.

The only reason that we use the photographic process is because it is the time-honored astronomical method of doing it. Also, at the time we had to get this thing done in a virtual hurry, and it was by far the best way of doing it to get the accuracy that we needed.

However, now in the 3 years that have elapsed, electronic techniques have come a long way. We are looking very strongly into the possibility of—again to use a popular term—using electronic telescopes for future work, which I think would then extend the range of optical tracking to the moon.

The CHAIRMAN. You have no such recommendation at this time?

Dr. HYNEK. The only recommendation I would have, sir, is that we—as a matter of fact, I do have and will shortly have a proposal to NASA, in this direction.

The CHAIRMAN. You mean that type of proposal?

Dr. HYNEK. That type of proposal, yes, sir.

Mr. FULTON. How soon should we plan on a telescope that is operating on a satellite or that you can adopt to missile propulsion?

Dr. HYNEK. There is work now very actively going on under the auspices of NASA on a telescope in a satellite. I would feel that in a matter of 2 or 3 years we might expect that.

Mr. FULTON. You spoke on your photographic plates, I believe, that the spaces between the solid lines on the photographic plate when you took the satellite in its course were caused by the rotating of the satellite.

Actually don't you mean that it was going end over end rather than rotating on its axis? It was tumbling, wasn't it?

Dr. HYNEK. That particular photograph, sir, I believe was the photograph of 1958 Beta II, which is a 6-inch sphere. In that case I think it would be rotating. If it were a pencil like this, then it would be proper to speak of it as tumbling.

Mr. FULTON. If it was a sphere, how does it happen you get blank spaces on your plate? Are you sure it was not the shutter of your camera or a flutter in your camera?

Dr. HYNEK. I can answer that one easily. Because if it had been a flutter in the camera, then it would have shown up in the star trails also. These don't show it. The matter of fact is, I am fairly certain that this was caused by—I don't have a convenient sphere here. But if you recollect the pictures of the 6-inch Vanguard, it had little windows for the solar batteries; and as the sphere turns, those come in line of sight; and it is those that interrupt the reflection of light and make the breaks in the trail.

Mr. FULTON. As the sphere goes, it would always have the same reflection from any planet or from the sun, wouldn't it?

Dr. HYNEK. The solar battery windows are black, and of course the sphere——

Mr. FULTON. So it would be that which would cause it?

Dr. HYNEK. It would be that which would cause it; yes, sir.

Mr. FULTON. Let me just finish with this, and I am through. You have said that if there had been 3 hours' difference in time of launch it would have meant a 3-months difference in the use of the Smithsonian facilities for this precision optical tracking.

Dr. HYNEK. Virtually that, yes.

Mr. FULTON. Do you think that it could have been a better launch had they first consulted with you to find that out?

Dr. HYNEK. I am not really competent to answer that question, sir, since I don't know which particular experiments were contemplated in that particular satellite.

Mr. FULTON. At least you could have tracked it visually if they had just simply launched it 3 hours later.

Dr. HYNEK. That is correct.

Mr. FULTON. You were not given the chance to balance out what your program might have been as against other programs that were built into the particular satellite, were you?

Dr. HYNEK. That's right.

Mr. FULTON. That is all.

Mr. QUIGLEY. Mr. Chairman, may I just ask one question?

The CHAIRMAN. Mr. Quigley.

Mr. QUIGLEY. Doctor, to date what has been the maximum range at which you have made effective visual tracking from Cambridge? How far from the earth?

Dr. HYNEK. The general order of about, I would say, 10,000 miles. This is in conjunction, of course, with satellites that don't go out much beyond that.

Mr. QUIGLEY. How large a satellite was that?

Dr. HYNEK. In that event that was Explorer 4, which incidentally I might say we had been consulted on considerably in advance, because you see, in order for the geiger counts to be significant, it is necessary to know where the satellite is when the counts are coming in.

Smithsonian provided for Dr. Van Allen and his group so-called

ephemerides, minute by minute positions of the satellites, so the count could be correlated with the space position.

I am sorry, sir. The specific question?

Mr. QUIGLEY. The specific question was the maximum range at which you have been able to come up with effective visual tracking.

Dr. HYNEK. I would have to check that, but I think about 10,000 miles.

Mr. QUIGLEY. How about on the several moon probes? Did you track those successfully for a time?

Dr. HYNEK. The moon probes go out so rapidly and so fast they become so faint so quickly that it is almost pointless.

Mr. QUIGLEY. So you have done your work almost exclusively on the satellites in orbit?

Dr. HYNEK. Yes.

The CHAIRMAN. Doctor, I want to ask you one more question. You say that the 3 hours' difference would have been the equivalent of 3 months. In other words, to get in the proper position again, we will have to wait 3 months for that satellite. Is that correct?

Dr. HYNEK. I would have to check those figures, sir. But my recollection now is that the orbit being as it is, that it would be the earth's orbital motion around the sun that would bring it into the normal twillight visibility zones.

I don't know the anticipated life of the satellite.

The CHAIRMAN. Would you make the effort now at the end of that period to see whether or not you can visually observe that satellite?

Dr. HYNEK. I think we certainly would, sir.

The CHAIRMAN. If it is still in orbit.

Dr. HYNEK. If it is still in orbit.

The CHAIRMAN. If it is rotating, then you ought to be in position at the end of 3 months' time to observe it perhaps as well as you would have been had it been launched 3 hours later. Is that correct?

Dr. HYNEK. That is correct, sir.

Mr. FULTON. That would be the time—3 months at the equator; but it would not be 3 months at every one of the stations about which you have commented.

Dr. HYNEK. I really wish I had the model of the earth here. A polar orbit differs so much from these others, that since the twilight goes almost from north to south, as the orbit moves into that, you almost get twilight visibility along the whole cut, you see.

Mr. FULTON. So there is not any appreciable time difference as to the inclination from the equator?

Dr. HYNEK. Right.

The CHAIRMAN. You might observe it on any station?

Dr. HYNEK. Yes, sir.

The CHAIRMAN. That covers it. I am going to ask counsel, when this testimony is transcribed, to submit it to the operating authority there and ask them why the satellite was not launched 3 hours later, as suggested by the doctor.

Mr. MOELLER. May I ask one more question of the doctor?

The CHAIRMAN. Mr .Moeller.

Mr. MOELLER. Dr. Hynek, this is a very elementary question, but what is the scope of astronomy? Where do you go and where do you stop?

Dr. HYNEK. Astronomy is the study of the whole universe, literally.

Mr. MOELLER. Unlimited?

Dr. HYNEK. Absolutely unlimited. You have given me an opportunity to say at this point that with the coming of telescopes in satellites, that will mean as much to astronomy as Galileo's building of the telescope in the first place.

It is an entirely new dimension.

Mr. MOELLER. In other words, all these probes that we will engage in are right, so to speak, in our alley?

Dr. HYNEK. That is correct.

Mr. FULTON. May I suggest to the Reverend Mr. Moeller, when God's laws take over, man's laws leave off.

The CHAIRMAN. We thank you very much, Doctor, for your coming here today.

Mr. FULTON. I want to thank you on the record for appearing, too.

The CHAIRMAN. We will adjourn until tomorrow morning at 10 o'clock.

(The letter from ARPA relating to Dr. Hynek's testimony is as follows:)

ADVANCED RESEARCH PROJECTS AGENCY,
Washington, D. C., March 20, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics,
House of Representatives.

DEAR MR. CHAIRMAN: Mr. Johnson has requested that I respond to your letter of March 14, 1959, respecting the testimony of Dr. J. Allen Hynek on the recent launching of the Discoverer I satellite vehicle.

As you are aware from previous testimony, the Discoverer series of launchings has as one of its long-term objectives the establishment of a capability for recovery of a space vehicle package. As an inherent element of this long-range programing, it has been necessary to plan the launching of the Discoverer satellites so that they will be in the recovery area of the Pacific Ocean during daylight hours. It would obviously be infinitely more cumbersome and difficult to attempt night recoveries of such vehicles. Even though no recovery attempt was programed for this vehicle, it was considered that these long-range requirements and certain preliminary measurements necessitated a launching which would place this vehicle over the Pacific Ocean area during daylight hours.

Although Dr. Hynek is a continuing and valued contributor to the overall space track network operated by the Department of Defense, it was considered that the requirements for daylight operation outweighed in this instance the possibility of utilizing Dr. Hynek's visual observation capability.

Sincerely yours,

W. H. GODEL,
Director, Policy and Planning.

(Whereupon, at 12:30 p.m., the committee recessed, to reconvene Friday morning, 10 a.m., in room B–214, Old House Office Building, to consider another subject.)